POWER

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Getting Things Done

THERE are men who have the faculty of getting things done. When they get on the job things move.

They do it not so much by driving and prodding as by directing the men under them.

They are alive with the purpose of accomplishment. They visualize the completed work or the results of a continuing process, know the means for doing or conducting it and see that they are constantly employed.

Like the conductor of an orchestra they co-ordinate and harmonize the activities of their working force, keeping them pulling in the same direction, at the same time and to the same end.

While each performer sees and executes his part of the work the leader sees it as a whole.

The man who is most successful in getting things done is he who has the knack of inspiring his subordinates with a real interest in the job, of making them feel not that they are "hewing stone" but that they are "building a cathedral," of making them share with him the satisfaction of difficulty overcome, of purpose achieved.

Not only in directing the work of others but in the ordering of one's own activities does this faculty of getting things done manifest itself.

It is not always the busiest man who gets the most done. You have seen men who come to their work with no well-arranged plan for the day, cutting in lustily at whatever is first or nearest at hand or which at the moment appeals most to their interest without considering related things; wasting time on overattention to the immaterial while the essentials drag, fuming and worrying about what they have not instead of doing the possible with what they have.

And when they are criticized because things are not done they insist that they have been on the job every minute and worked harder than anybody else in the shop.

The man who makes his head save his hands, who does the thinking for and spurs the interest of the crowd, is the man who gets things done He is the man that industry is on the hunt for, the man who is on his way to the top.

F. R. Low

EDITORIALS

Oil Engine Manufacturers Have Not Fallen Down

IN A SURPRISING statement before the House of Representatives, Congressman Britten, Chairman of the House Committee on Naval Affairs, has stated that the manufacture of diesel engines had "fallen down" in the United States and had not been able to compete with that of foreign countries. In support of this Rear Admiral Yarnell, Chief of the Bureau of Engineering, recommended an expenditure for foreign engines to be used as models, stating that it is admitted foreign engines are superior to the domestic product. In substantiation of this, he claimed that the Shipping Board's diesel program had not proved satisfactory.

These two statements are so misleading that they can not be allowed to stand unanswered.

Just what did happen with the Shipping Board's program, and why is it termed unsatisfactory? In the first place, at the time the Shipping Board received authorization to recondition a number of vessels by installing diesel engines, only a few American manufacturers had actually built a diesel engine in excess of 1,000 hp., while the new service required machines three times this size. With commendable foresight it was planned that the work should be done in the United States and by diesel manufacturers, many, if not most of whom had, and still have, technical connections with leading European diesel engine builders.

The specifications were extremely rigid in performance requirements and, because it was government work, prices had to be strictly competitive. A number of the builders felt the prospective orders would be forerunners of an extensive dieselization of American shipping and offered prices known to be below the cost of manufacture, as future orders for similar machines were hoped for.

A total of twenty-three ships were fitted with diesel engines and, because of the laudable desire to spread the work among as many builders as possible, in combination with the necessity for maintaining the competitive features of the bidding, some of the companies wanting a portion of the work actually had to accept it upon a "take-it-or-leave-it" basis. The Shipping Board required the strictest adherence to the specified performance, but despite this, and some instances of difficulty at first due to design omissions, it is significant that, with possibly one exception, every one of the ships originally fitted with these diesel engines is in commission today and performing yeoman's service.

It is no secret that trouble had to be ironed out at the start. Neither is any secret ever attached to the fact that in the finest steam vessels starting operations are expected to be accompanied by the straightening out of kinks here and there. Certainly the Shipping Board diesel engines were no more troublesome than those in some foreign motor ships coming regularly into American ports, the history of which is available to anyone interested.

Perhaps the outstanding lesson to be learned here will be found in the fact that foreign shipping operators expect minor troubles on motor ships quite as much as on steamers, while some American operating companies, through lack of experience, have been inclined to view each minor difficulty as a calamity.

Are American designs inferior, and if so, why? Perhaps the earlier ones were. It is true that the diesel came to us from Europe and it is there built in larger sizes than have yet been attempted here. Nevertheless, Europeans think well of American designs. One European manufacturer builds engines identical in many respects with an American prototype. Both are the product of the same highly experienced design staff. Another European company builds a diesel under license from an American company, and an English concern is licensed by still another American company. These facts are not to be overlooked.

Marine engines of present-day design built by American companies have performance records as excellent as those of European manufacturers. They are less complicated, as they must give splendid service when operated by a class of men less experienced and skilled than the engineers on foreign vessels.

Moreover, American engines have operated on fuels that European diesels would not burn. Tests at the Naval Experiment Station bear out this statement. These tests, conducted by an experienced Naval officer, reveal that even an American crankcase-scavenging diesel could burn oil impossible to handle in a German submarine diesel said then to be the last word in design.

Because in the past the market demand has been lacking, American manufacturers may not have progressed as far with the development of light, high-speed oil

engines as some European builders. The facilities and technical capacities are, nevertheless, fully available here to carry out any designs and construction of this kind that may be warranted by the marketing possibilities. Neither must it be forgotten that practically all the progress in the reduction of engine weight in European designs is the result of government orders placed with firms that admittedly had not made such light engines before.

Diesel engine manufacture in the United States has progressed, despite the expensive experience with the Shipping Board program. The splendid work it is doing is seen on all sides. It has shown its competence in all respects, and if any government department is dissatisfied with the progress of diesel engineering and construction in the United States it should devote its appropriations to American industry.

Failing in the amount of support and assistance to American builders that European governments have given their manufacturers, they should not give voice to any thought that the United States has "fallen down" in the manufacture of diesel engines.

Power is opposed to any expenditure for foreign engines for experimental or any other purpose until such time as American diesels have been properly given their opportunity in marine service and it is proved that they can not meet requirements. Would not the country be better off and the Navy be more helpful if it expended its money for the material encouragement and assistance of a worthy American industry instead of competing with it?

The Government's Employment Aid

SPLENDID work is being accomplished by the President's Emergency Committee for Employment. The two pamphlets recently issued by the committee have given needed publicity to the progress of methods for spreading employment and adjusting industrial operations to the demand for manufactured products so fluctuations in employment may be reduced to the minimum. The fact that a surprisingly large number of important companies recognize the moral obligation to their employees and have taken steps to ameliorate the distress of workmen and their families will encourage other institutions to do likewise. Nothing but good can result from these activities.

But withal, the maximum effort in this direction still leaves much to be done in other ways. Among them, the immediate problem of providing work for surplus workmen has been promptly attacked in Congress by the authorization and appropriation of funds for public works and building jobs amounting to hundreds of millions of dollars.

This work will require a large amount of power machinery. So far so good. But of what avail is it for immediate relief, if governmental red tape and lack of capacity of government departments makes it impossible to get the drawings, plans and specifications issued and the work started? Hardly twenty per cent of the funds appropriated has, so far, been made applicable to actual orders. Fortunately the President's Emergency Committee for Employment is aware of this, and a public and semi-public works section has been formed, whose special endeavor shall be to ascertain why authorized projects are not going forward.

It is practically certain they will find a large portion of the delay centers in the architect's office. Strong evidence points to it as the present neck of the bottle. Meanwhile a host of willing workers is ready and waiting for the opportunity to get into production. Surely there is a way to set aside the routine obstacles to action in the present emergency.

A Call for Disinterested Experts

FOR THE future welfare of the country, it is essential that the average citizen learn more of certain economic fundamentals in the field of power. This knowledge must be brought to him by men of sound knowledge, gifted in the art of explanation and free from all suspicion of axe-grinding. The public is suspicious, and rightly so, of expert advice from interested parties. It is therefore particularly incumbent upon engineers free from such connections and born with some gift of expression to take a public stand on engineering matters of national importance in so far as they are subject to analysis on a basis of fact.

Disinterested statements would probably, by their very impartiality, fall short of satisfying completely any commercial or political group. They would not be entirely satisfactory to the utilities, to the advocates of municipal ownership, or to the industrial plants that are, in one sense, competitors of both.

They would not entirely please those who predict magical rate reductions by public development of large water powers, nor, on the other hand, give complete satisfaction to certain private interests seeking undue advantage from the development of such powers.

This very failure to play up to anybody by the sacrifice of truth would give great weight to such pronouncements and hasten the arrival of wise action, so long delayed in the tug-of-war of opposing interests.

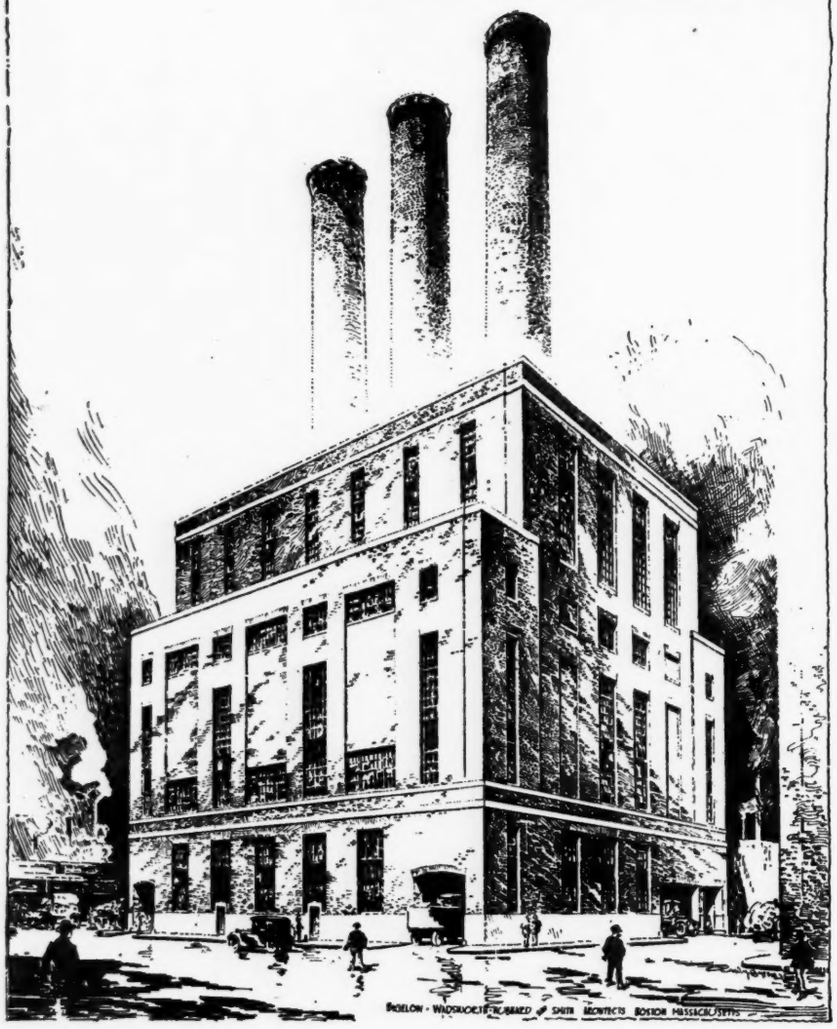
▼

POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

SIMPLICITY Is the Keynote of Boston's

New plant of Edison Electric Illuminating Company is designed to fit the economic requirements of central heating, which differ fundamentally from those of electric service



This sketch shows the plant as it will look with the ultimate installation of six boilers

SUPERFICIALLY, a central heating plant has much in common with a steam-electric generating station. Both have complete boiler rooms, with all the attendant equipment. Both distribute a service to numerous customers. For this reason the casual observer sees no occasion for comment in the fact that some central heating plants are practically replicas of central electric station boiler rooms of the same era.

Yet there is a marked economic difference between plants for these two services. What pays in one will not pay in the other. This fundamental underlies the whole design of the central steam heating plant recently completed by the Edison Electric Illuminating Company near the business heart of Boston, Mass. Net result: A plant of extreme simplicity.

Fundamentally Different From Central Station

The first broad distinction between heating and electric plants is load factor. With little summer load, the heating plant may achieve perhaps 20 to 25 per cent as against 40 to 50 per cent for an electric plant. Obviously, this decreases the money that may be spent for high efficiency. The higher cost of steam-distributing systems and higher distributing losses per mile are other factors. Their chief effect is on location; the heating plant must be close to the load, generally a congested business district. This, in turn, makes clean stacks a primary requirement. Again, no bled steam is available for feed heating in the central heating plant. This gives turbine drives of auxiliaries a special advantage.

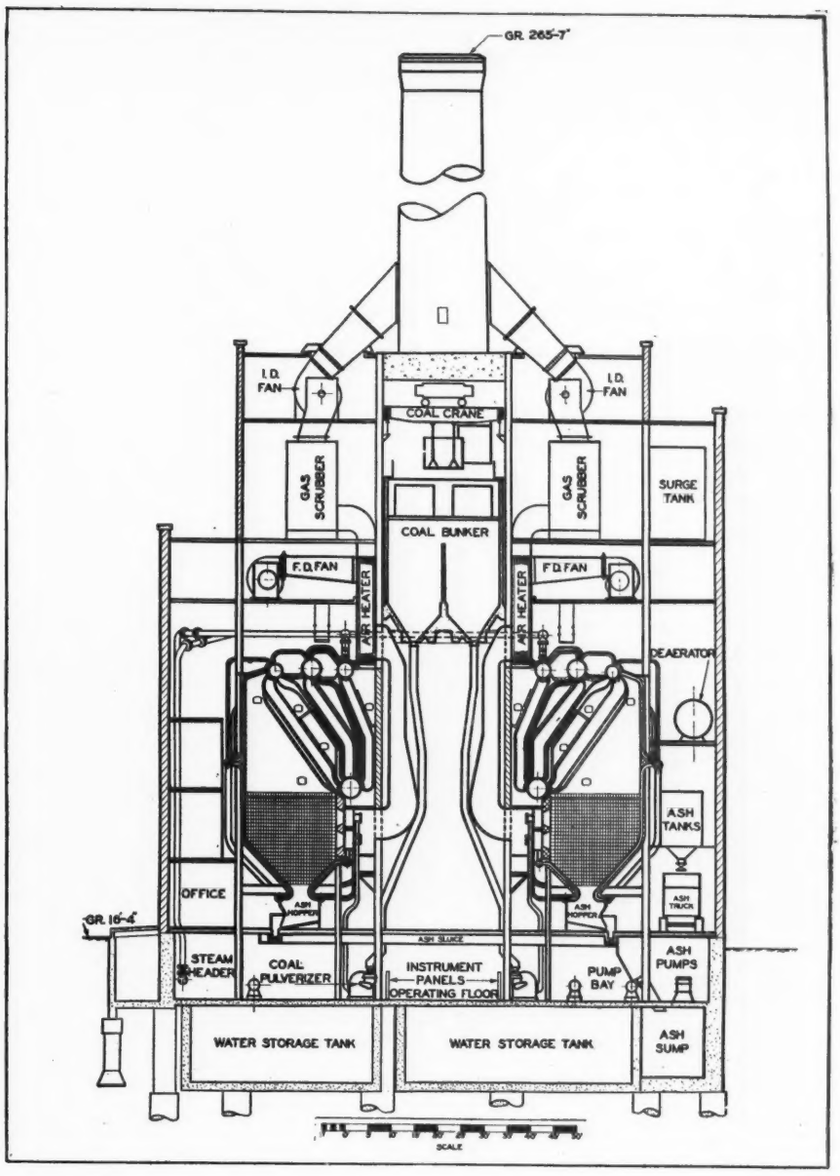
These facts and many others were brought to light in a study made some years ago by the Edison company. For 25 years this company has generated steam in many small leased building plants to supply downtown office buildings. In recent years the demand rose close to the capacity of these plants. Their equipment was becoming obsolete and the time seemed ripe for replacing all of them by a single central plant.

While the preliminary studies did not reveal any opportunity for high profits from this business, they did indicate that the central plant would pay its way with an expanded load if it was specifically designed from the ground up to meet the heating demand at the lowest over-all cost.

Detailed studies for the actual plant were started in 1928. Construction began in 1929, and the plant went

Kneeland Street Heating Plant

By P. W. SWAIN
Associate Editor of POWER



Designed for low-cost steam at 20 per cent load factor, Kneeland Street has few frills

into operation on Oct. 26, 1930. Costs were kept down first by location at the edge of an industrial district, adjacent to the principal business district. This insured minimum transmission costs. Secondly, refinements were introduced only where the resulting efficiency increases or other operating advantages would pay their way on a 20 per cent load factor.

Clean Stacks a Necessity

It was decided, however, that clean stacks were an essential regardless of expense. After a thorough study of the devices available, it was decided that gas scrubbers would result in the most satisfactory solution of the problem. Pulverized fuel was chosen for the plant, but this choice had nothing to do with the installation of flue gas scrubbers, which would have been required in this locality regardless of the method of firing.

The specially designed wet scrubbers used were adopted after tests demonstrated that they would remove practically all of the stack solids. When it is considered that fuel burned in the central plant replaces a greater quantity of fuel burned in many small plants, with poor combustion conditions, it is evident that the change should help considerably to clean up the city's atmosphere.

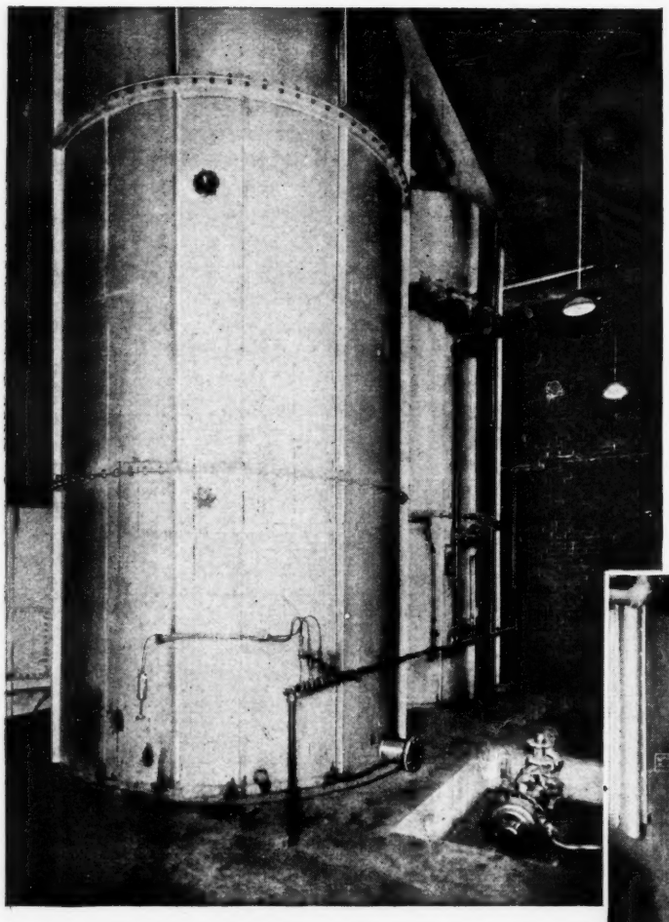
Since the principal equipment is listed at the end of this article, no attempt will be made to describe the plant in detail. The main features only will be outlined, with comments on their economic background.

Two 19,030-sq.ft. boilers are now installed, with ground room for four more. Each has a steaming capacity of 250,000 lb. per hour. No superheaters or economizers are used, but each boiler is connected to a 16,920-sq.ft. tubular air heater. The operating boiler pressure is 210 pounds.

Pulverized coal, fired by two unit mills per boiler, is burned with a maximum heat release of 28,000 B.t.u. per cubic foot. (Furnace volume is 11,380 cu.ft.) This rate of driving makes water-cooled walls a necessity. The feed (good city water) is treated in zeolite softeners, after which sodium sulphate is added to maintain the required sulphate-carbonate ratio in the boiler.

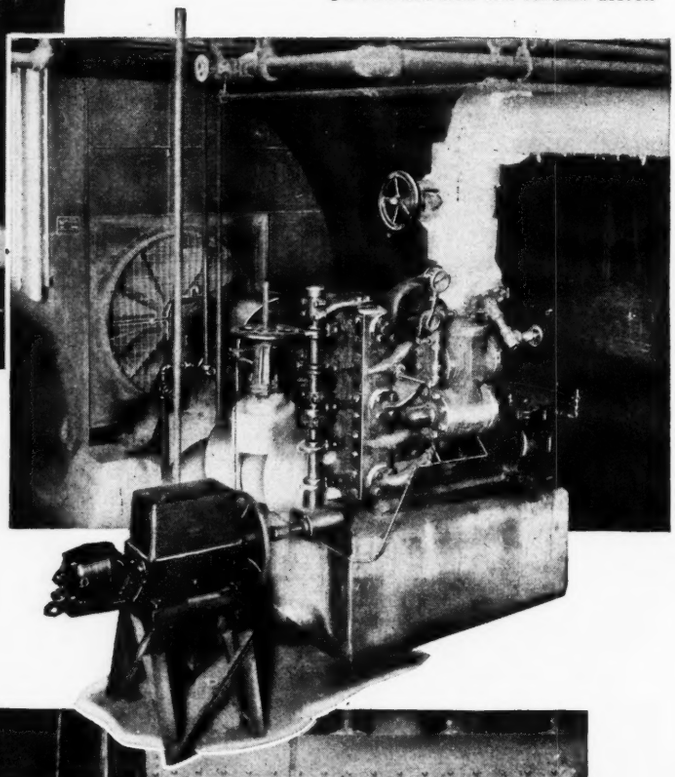
Trucks Dumped Directly Into Bunkers

The coal-handling system is extremely simple. Cost studies showed that it would not pay to extend sidings from a near-by railroad. Instead, coal is carted in trucks

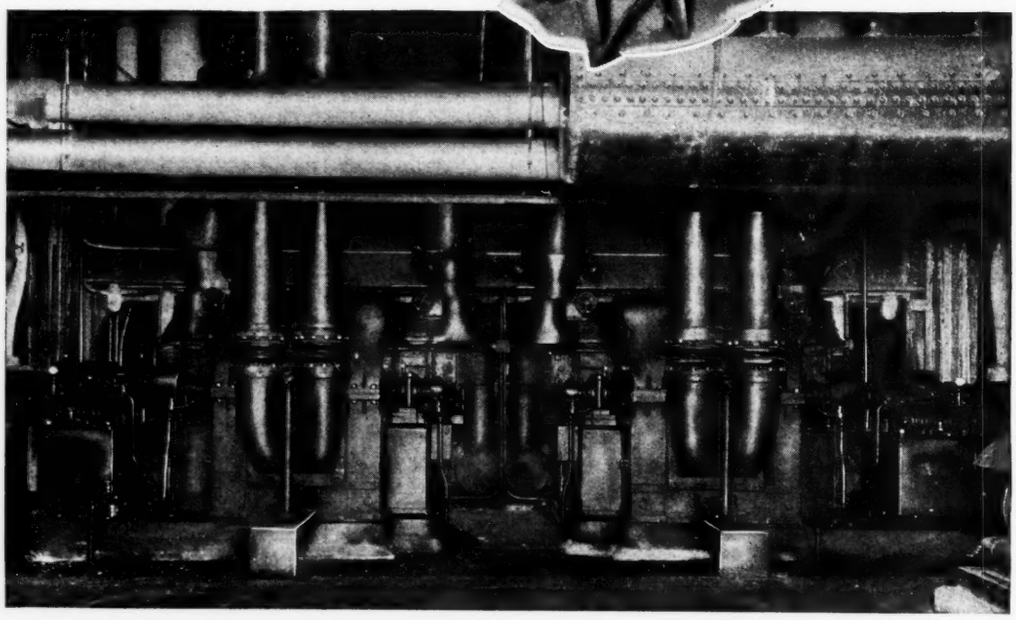


Transmission costs are a far more important element in steam service than in electrical. The wet scrubbers insure clean stacks, thereby permitting location close to load center

Forced-draft fan driven by 400-hp. steam turbine. Induced-draft fans, one feed pump, service pumps and pulverizers also are turbine-driven



Below—The duplex pulverizers (two per boiler) are turbine-driven through reduction gears. Water-wall furnaces are operated at a maximum heat release of 28,000 B.t.u. per cubic foot per hour



with seven-ton dump bottoms. The containers are picked up by a traveling crane which dumps their contents directly into the overhead bunker. Ash is handled by hydraulic sluicing to a pit in the basement. From this it is delivered by a dredge pump to elevated ash tanks, where the water is drained off. The ash is then removed by trucks.

Turbines were chosen to drive pulverizers, forced and induced fans and the boiler-feed and service-water pumps. Exhausting to a deaërating open feed heater, they showed the lowest total of operating cost and fixed charges. Incidentally, the simplicity of control made possible by the use of turbines contributed to the choice of complete automatic control, which showed a saving in spite of low load factor.

Each induced-draft fan is driven by a 700-hp. geared turbine. Forced-draft fans are geared to 400-hp. units. Of the two boiler-feed and service-water pumps provided, one of each is turbine driven.

Every element in the design of the Kneeland Street plant is based on careful studies of actual cost rather than on precedent. Its designers believe that operating figures will pustify them in the elimination of certain refinements that are common in steam electric stations. This plant exemplifies a growing and commendable tendency to get back to economic fundamentals in plant design.

The writer here expresses his indebtedness to George E. Seabury and Melvin D. Engle of the Edison Electric Illuminating Company, for the information upon which this article is based.

Principal Equipment of Kneeland Street Heating Plant

General

Location, Kneeland and Utica Streets, Boston, Mass.
Service, steam supply to downtown industrial and business district.
Construction started, summer of 1929.
Went into operation, Oct. 26, 1930.
Engineering by Edison Electric Illuminating Co. of Boston.

Building

Superstructure Contractor, G. K. & C. A. Root, Boston.
Foundation and Substructure Contractor, The Gow Company, Boston.
Dimensions, 120 ft. wide x 125 ft. high x 60 ft. long (present) (140 ft. ultimate).
Foundation, concrete caisson, sunk 110 ft. below street level to bedrock.
Construction, steel frame. Curtain walls of tile and cinder block with brick veneer.

Boilers and Boiler Equipment

Number, present 2, ultimate.....6
Type, Stirling, Class 25, 42 tubes wide.
Make.....Babcock & Wilcox Co.
Water heating surface, sq.ft.....19,030
Pressure, lb. gage.....210
Superheat .....None
Capacity, lb. per hour.....250,000
Air heaters, one per boiler, tubular type, Babcock & Wilcox Co.
Heating surface, sq.ft.....16,920
Safety valves, 7 per boiler, Consolidated Ashcroft Hancock Co.
Feed regulators, 2 per boiler.....Bailey Meter Co.

Furnaces

Method of firing, pulverized fuel, unit system.
Furnace volume, cu.ft.....11,380
Walls, water-cooled.....Fuller Lehigh Co.
Firebrick ..... { Portland Stoneware Co. / Harbison Walker Refractories Co.

Coal and Coal-Handling Equipment

Kind of fuel, New River, semi-bituminous.
Source of supply, brought by truck from South Boston.
Handling, seven-ton dump-bottom containers lifted by traveling crane and dumped directly into bunker over boilers.
Crane, 15-ton.....Cleveland Crane-Engineering Co.

Pulverizing and Firing Equipment

System .....Unit
Mills, 4 (2 per boiler) 4 duplex Atrita, Riley Stoker Corp.
Capacity each, lb. per hr.....12,500
Burners, turbulent type, forced blast, Riley Stoker Corp.

Ash Handling

System....Hydraulic sluicing, repumped from pit to storage tanks, emptied to trucks.
Equipment, ash hoppers, sluiceway, sluice pumps, dredge pumps.....Allen-Sherman-Hoff Co.

Draft Equipment

Induced-draft fans, two (1 per boiler), Buffalo Forge Co.
Capacity, 145,000 cu.ft. per min. at 17 in. suction and at 500 deg. F.
Drive, 700-hp. geared turbine..B. F. Sturtevant Corp.
Forced-draft fans, 2 (1 boiler)..Buffalo Forge Co.
Capacity, 96,000 cu.ft. per min. at 17 in. static pressure.
Drive, 400-hp. geared turbine..B. F. Sturtevant Co.
Ducts and breechings.....Connery & Co.
Stack, brick, completely lined, Alphons Custodis Chimney Construction Co.
Internal diameter at top, ft.....15
Height (above ground), ft.....250

Fly Ash Removal

System, wet scrubber, Pease-Anthony Co. patents.
Made by .....B. F. Sturtevant Corp.

Feed Water and Equipment

Make-up, per cent.....85
Source .....Boston city mains
Quality, very good; Hardness, gr. per gal.....2
Zeolite softeners, three units.....Permutit Co.
After treatment, sodium sulphate; equipment by, Permutit Co.
Deaërating open heater, 700,000 lb. per hr., Cochrane Corp.
Feed pumps, two, centrifugal...Ingersoll Rand Co.
Drive, one 440-volt induction motor, 350 hp., Westinghouse Elec. & Mfg. Co.
One 350-hp. turbine.....B. F. Sturtevant Co.

Miscellaneous Pumps

Scrubber make-up, Worthington Pump & Machinery Corp.
Bearing cooling, Worthington Pump & Machinery Corp.
Scrubber recirculating.....Le Bour Pump Co.
Sump.....Nash Engineering Co.
Priming .....Nash Engineering Co.

Piping

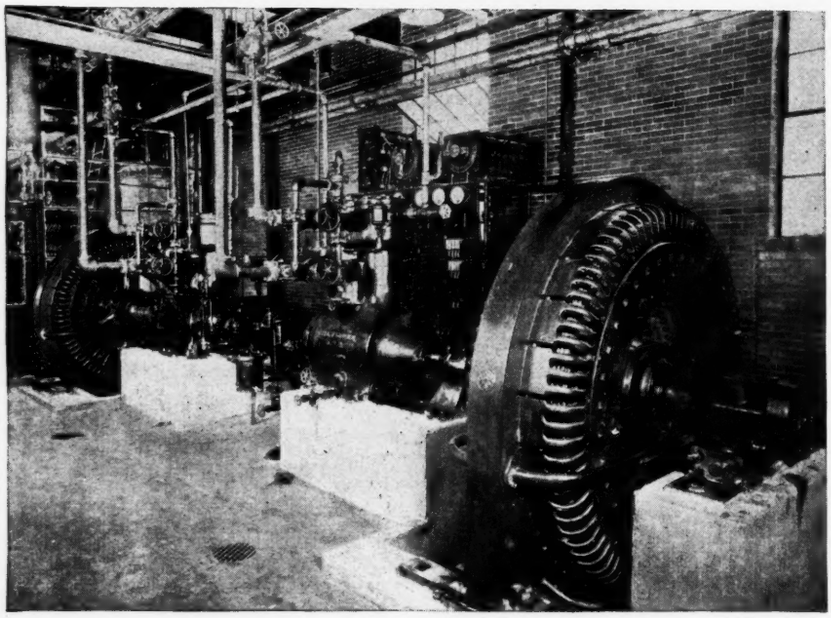
Piping contractor.....Lumsden & Van Stone Co.
High-pressure steam, standard-weight pipe with extra heavy valves and fittings and Van Stone flanges.
Exhaust steam, standard-weight pipe with welded line joints and Van Stone flanges at valves and fittings.
Feed piping, standard-weight pipe with welded line joints. E. H. valves and fittings and Van Stone joints.
Heat insulation, 85 per cent magnesia, Keasby & Mattison Co.

Valves

Gate.....Chapman Valve Mfg. Co.
Globe .....Crane Co.
Swing check .....Crane Co.
Boiler non-return .....Schutte Koerting Co.
Globe checks .....Schutte Koerting Co.
Pressure reducing to transmission main, Bailey Meter Co.
Small pressure reducing.....C. E. Squires Co.
Automatic combustion control....Bailey Meter Co.

Instruments

Flow meters, boiler leads.....Bailey Meter Co.
Flow meters, others.....Brown Instrument Co.
Recording pressure gages.....Foxboro Co.
Long-distance pressure recorder.....Bristol Co.
Recording thermometers .....Foxboro Co.
Indicating pressure gages....Star Brass Mfg. Co.
Boiler water level indicators, Boiler Room Improvement Co.



Two-speed synchronous motors driving two-cylinder, single-acting vertical ammonia compressor in a hospital

Two-Speed Synchronous Motors Drive Compressors

Five synchronous-motor torques are considered in the application of this equipment to reciprocating compressor drives. To allow operating compressors at reduced output a two-speed synchronous motor has been developed and machines of that type are now in service

By H. E. LARSON
Industrial Engineering Department
General Electric Company

RECIPROCATING compressors occupy an important place in industrial processes for compressing air and other gases. Synchronous motors have become virtually standard drive for these applications. Except in cases of old compressors formerly steam driven and of small compressors requiring less than 20 hp., to which flat or V-belt drives are usually applied, the motors are directly connected to the machine. Generally, the motors are furnished by the motor manufacturer without base, shaft or bearings for mounting on the compressor shaft. It is possible to couple a motor having its own base, shaft and bearings, but that is rarely done, because of the cost of these parts and the additional space required.

Synchronous motors are the most economical and efficient low-speed alternating-current drive. Some power companies have incorporated power-factor bonus clauses in their contracts. As a result industrial plant owners have found it economical to use synchronous motors wherever possible for power-factor improvement. Also, the synchronous motor has a high efficiency at all but very light loads.

Improvements in design of squirrel-cage windings in the polefaces have made it possible for direct-connected synchronous motors to develop sufficient torque to meet any requirement. By using various combinations of copper and brass squirrel-cage bars, either starting torque or the pull-in torque may be favored. A high-resistance squirrel-cage winding of brass bars gives a compartively high starting torque. A low-resistance winding of copper bars gives a high value of torque just before synchronizing. The average value of these torques may be varied within limits, to suit requirements, by embedding the bars at various depths from the polefaces. By employing two rows of bars, one deeper than the other, high starting torque with a low starting current is obtained. Fig. 1 shows a typical synchronous motor rotor with a squirrel-cage winding in its polefaces.

The full-voltage starting current taken by 60-cycle, unity-power-factor motors, of normal torques and operating at speeds between 240 and 450 r.p.m. and at 2,200

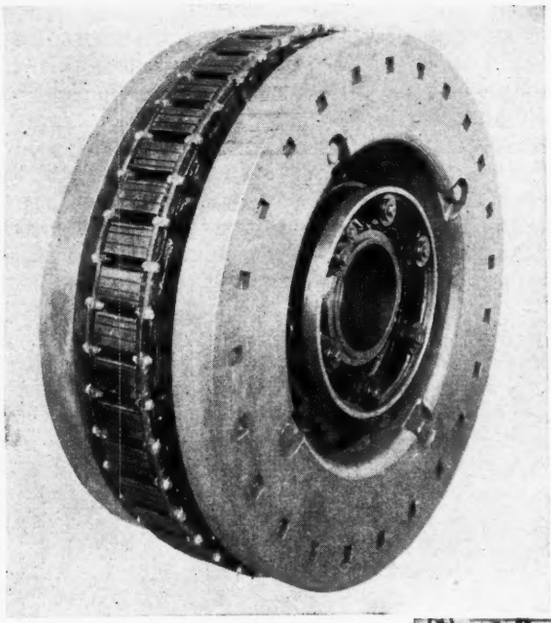


Fig. 1 — Synchronous motor rotor, showing squirrel-cage winding and ballast rings

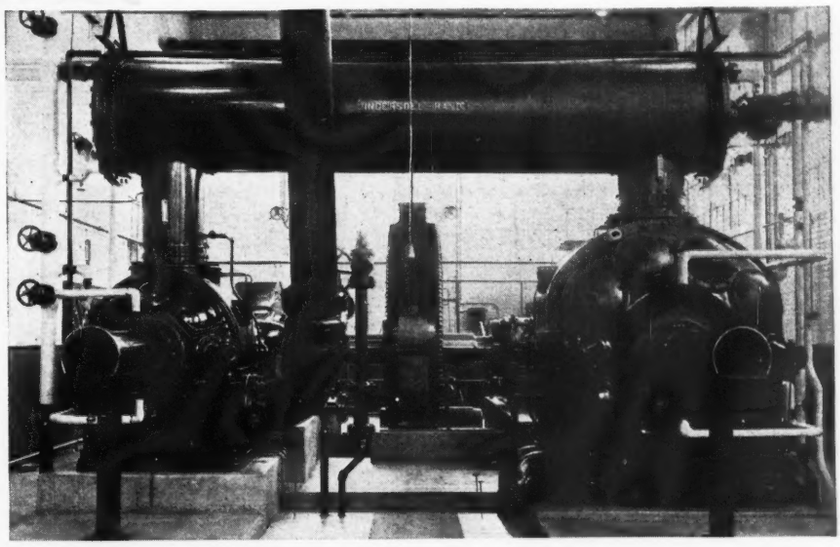


Fig. 2 — Synchronous motor driving two-cylinder, double-acting, two-stage air compressor

volts or less, is approximately 300 per cent of full-load current. For motors operating at speeds below 240 r.p.m. the starting current is approximately 250 per cent. These values are low enough to allow full-voltage starting on almost any power system. Line starting simplifies control apparatus and makes it unnecessary to design motors for high torques in anticipation of using reduced-voltage starting.

To satisfy those cases in which reduced output of the compressor can be obtained by speed reduction only, the two-speed synchronous motor was developed. A description of this motor and a typical installation appears further on in this article.

There are five synchronous motor torques that are important in compressor drives. Fig. 3 shows the torque of an average low-speed motor, operating without excitation, plotted against speed. The torques are:

1. Starting torque starts the load and overcomes static friction. This is the torque developed by the motor at zero speed.

2. Accelerating torque brings the load from rest up close to synchronous speed.

3. Pull-in torque, a measure of the motor's ability to pull into step. It is defined as the torque developed by the motor at some speed below synchronous, such as 95 per cent speed. If the pull-in torque of a motor is given as 40 per cent at 95 per cent speed, it does not mean that the motor will synchronize 40 per cent load torque. It is simply a point on the torque-speed curve that may be used to compare the ability of different motors to pull a given load into step. A motor having 40 per cent torque at 95 per cent speed will bring a given load closer to synchronism than one having 30 per cent torque at 95 per cent speed.

4. Full-load torque, developed by a synchronous motor operating with rated excitation when it develops rated horsepower at rated speed. It is given by the relation

$$T = \frac{5{,}250 \times Hp.}{N}$$

in which

T = Torque in foot-pounds.
Hp = Rated horsepower output.
N = Speed in revolutions per minute.

This torque is important because starting, accelerating, pull-in and pull-out torque are generally expressed as a percentage of full-load torque.

5. Pull-out torque, the maximum torque developed by a synchronous motor, just as it is pulled out of synchronism, the motor operating at rated excitation. It is the torque that will just stall the motor. This maximum torque varies directly with the applied voltage, while the maximum torque of an induction motor varies as the square of the voltage.

Pull-out torque should be considerably greater than full-load torque, in order to allow for dips in line voltage. It is not desirable that the motor should drop out of synchronism when the voltage drops momentarily. Pulsating loads, such as compressors, require a pull-out torque somewhat greater than 100 per cent. Assuming the compressor to be equipped with sufficient flywheel effect to limit current pulsation to the accepted A.I.E.E. value of the 66 per cent, the driving motor should not have less than 140 per cent pull-out torque.

It was said previously that starting or pull-in torque may be favored by design. The table gives some typical limits of variation for different average torque values in per cent of full-load torque obtained with a single squirrel-cage winding and full voltage on the motor.

TYPICAL TORQUE VALUES FOR SINGLE SQUIRREL-CAGE WINDING SYNCHRONOUS MOTORS

Normal Torques,			High-Resistance		Low-Resistance	
Start	Pull-In	Average	Start	Pull-In	Start	Pull-In
40	40	40	50	30	30	50
50	50	50	65	35	40	60
60	60	60	75	45	50	75
70	70	70	90	50	55	85
80	80	80	100	60	65	95
90	90	90	115	65	70	110
100	100	100	125	75	80	120

The theory of operation of the double- squirrel-cage

winding accounts for the fact that lower starting current can be obtained by using this construction than is possible with the single squirrel-cage winding for the same average torque. At start the slip frequency is high. The lower bars have high reactance at high frequency compared to those near the air gap, because they are surrounded by a magnetic circuit of comparatively low reluctance. Most of the current at start, therefore, flows in the upper high-resistance bars, giving high start-

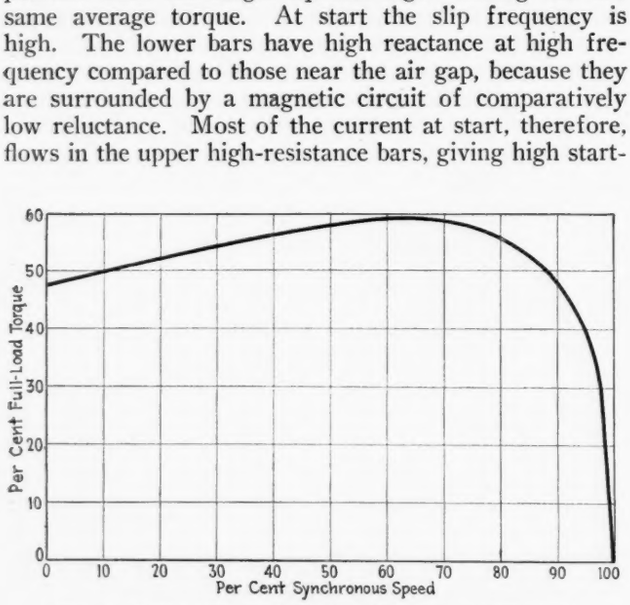


Fig. 3—Speed-torque characteristic of a conventional synchronous motor operating without excitation

ing torque. At pull-in, when the slip frequency is low, the reactance of the lower bars is also low. Having a lower value of resistance than the upper bars, they carry most of the current, giving the effect of a low-resistance squirrel-cage winding and high pull-in torque.

This foregoing is best illustrated by an example. Assume a synchronous motor with a single squirrel-cage winding in the polefaces that has the following characteristics: starting current, 250; average torque, 50; starting torque, 50; and pull-in torque, 50 per cent of full-load values. If the squirrel-cage winding were changed to a double-type construction the motor could be designed to develop the single squirrel-cage torques with 200 per cent starting current. Because its windings are planned independently for starting and pull-in torques, instead of the necessary compromise design, the same torques can be obtained with lower starting current than is possible with a single squirrel-cage winding.

It is hard to generalize on the value of torque that should be incorporated in low-speed motors driving reciprocating compressors. The torques recommended below are in excess of actual requirements, in order to provide reasonable margin for low line voltage, abnormal friction and other conditions. It is safe to say that 40 per cent starting, 40 per cent pull-in torque at 95 per cent synchronous speed and 140 per cent pull-out torque are ample for almost all types when full-voltage starting is employed, except some carbon-dioxide compressors. So-called increment starting is often used when the motor takes power from a city network or a small building power plant. In either case voltage regulators will maintain fairly constant voltage over the system if they are given time to act. Therefore, the starting load is applied gradually by cutting out series resistance in small increments, thus avoiding objectionable light flicker.

Compressors for CO_2, which were previously taken as an exception, generally operate with 400 lb. per square inch suction and 1,100 lb. per square inch discharge gage pressures. The bore of a CO_2 compressor is therefore much smaller than that of an ammonia compressor of the same brake horsepower rating, which usually operates with 20 lb. per square inch suction and 185 lb. per square inch discharge pressure. With a 5- to 6-in. bore a piston rod diameter of the usual 2 or 3 in. becomes 30 to 50 per cent of the piston diameter.

Consider a single-cylinder double-acting CO_2 compressor bypassed at starting: Upon opening the bypass valve the pressure in the compressor is the same in each cylinder end, roughly the average of the suction and discharge pressures, say 700 lb. per square inch. By reason of the greater force on the head end, the compressor always stops with the piston at the crank end ready for the head-end compression. As the motor starts the compressor it will be required to furnish a torque necessary to overcome a force equal to 700 lb. per square inch multiplied by the piston rod area, since the presence of the piston rod causes this difference in area. For that reason single-cylinder, double-acting CO_2 compressors generally require at least 70 per cent starting torque for full-voltage starting and 90 per cent starting torque for increment starting. A pull-in torque of 45 per cent is usually sufficient.

Two-cylinder, double-acting CO_2 compressors with cranks at 90 deg. generally require 60 per cent starting torque for full voltage and 75 per cent for increment starting, with 40 per cent pull-in.

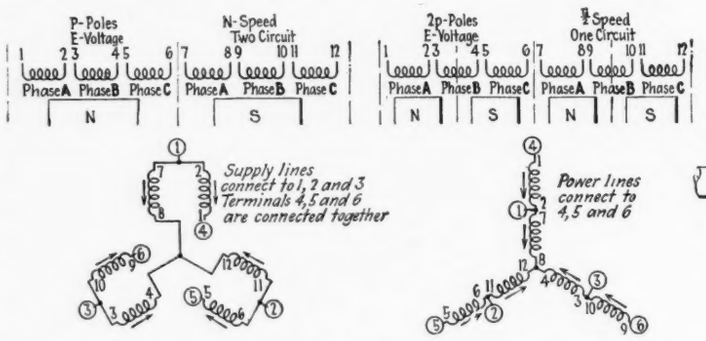


Fig. 4—High-speed connection for stator of two-speed motor

Fig. 5—Low-speed connection for stator of two-speed motor

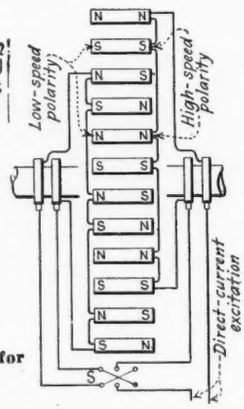


Fig. 6 (Extreme Right)—Two-speed synchronous-motor rotor connections

Two-cylinder, double-acting, single-stage, vertical CO_2 compressors with cranks at 180 deg. generally require 55 per cent starting torque for full voltage and 65 per cent for increment starting, with 40 per cent pull-in. All other common types of CO_2 compressors require only 40 per cent starting and 40 per cent pull-in torque.

With steam drive, a decrease in compressor output is obtained by reducing the speed of the engine. With the application of synchronous motors, unloading methods and devices have been developed. Air compressors employ both clearance pockets and methods in which the suction valves are held open. Large ammonia compressors employ clearance pockets and bypass ports that are

not so well adapted to the smaller sizes. The refrigerating field seems to prefer unloading by speed reduction, and it was to meet this demand that the two-speed synchronous motor was developed.

A connection diagram for the field poles of the two-speed synchronous motor is shown in Fig. 6. The stator connections for the high-speed condition are given in Fig. 4 and for the low speed in Fig. 5. The field poles are connected for the high-speed condition, so that two successive poles will have polarity *N*, while the next two

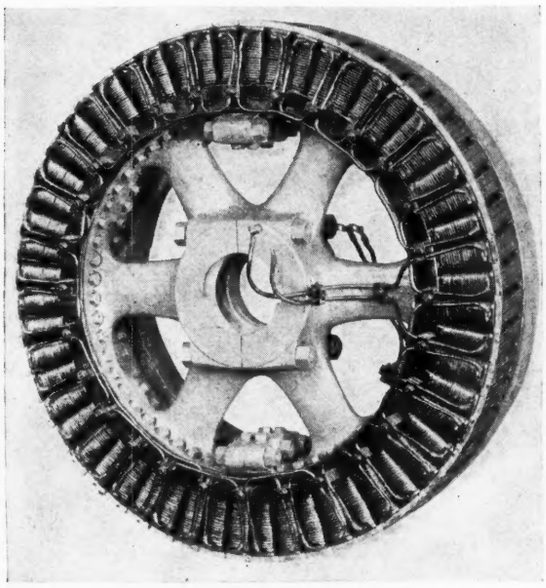


Fig. 7—Two-speed synchronous-motor rotor, showing field-coil connections

successive poles will be of reversed polarity *S*, according to Fig. 6. Thus four separate salient poles will form, magnetically, a pair of poles. For the low-speed condition the poles are connected in the usual series manner, each pole having a polarity different from the one adjacent. Every other pair of poles has the same polarity for both the high- and low-speed conditions, and the field coils of these poles are connected to one set of collector rings, Fig. 6. The pairs of poles, whose polarities must be reversed when changing from the high to the low speed, or vice versa, are connected to the other set of rings. By connecting the collector rings in series through a reversing switch *S* the number of magnetic poles may be changed in the ratio of two to one by changing the position of the switch. It follows that a two-speed motor must have as many salient poles as required by the lowest speed. Fig. 7 is a photograph of a rotor for a two-speed motor equipped with a ballast ring. The excitation per pole need be only slightly in excess of that required by a single-speed motor rated at the low-speed horsepower and speed.

The stator of a two-speed motor differs from that of a single-speed motor only in the coils and coil connection, as the frame and punchings are those of the single-speed motor. In order to have the flux density in the air gap approximately the same at both speeds it is necessary to have at low speed, as compared with high speed, twice the number of turns per phase in series. Also, the current through half of the turns per phase must be reversed. By inspection of Figs. 4 and 5 it will be seen that this is what has been accomplished. Fig. 8 shows the stator of a two-speed motor with six leads brought out corresponding to leads 1, 2, 3, and 4, 5, 6, of the wiring diagrams.

The two-speed motor can be designed for ample starting and pull-in torques to permit starting on either speed connection. Although the efficiency of the motor is somewhat lower than that of the single-speed machine, proper design will favor the speed at which the motor is to run. It is possible to attain an efficiency at this speed practically as good as with the ordinary type. The cost of a two-speed motor is comparable with that of a single-speed unit having equal horsepower and low-speed ratings.

An installation of two-speed motors in Christ Hospital, Cincinnati, Ohio, is shown at the top of page 138. The motors drive two-cylinder, single-acting, vertical ammonia compressors which are a part of the hospital's refrigeration system. The hospital has its own 60-cycle alternating-current power plant, which contains one 250-kva. and one 300-kva. generator. Only one generator operates at a time. It was required that the motors should be started in a manner that would pre-

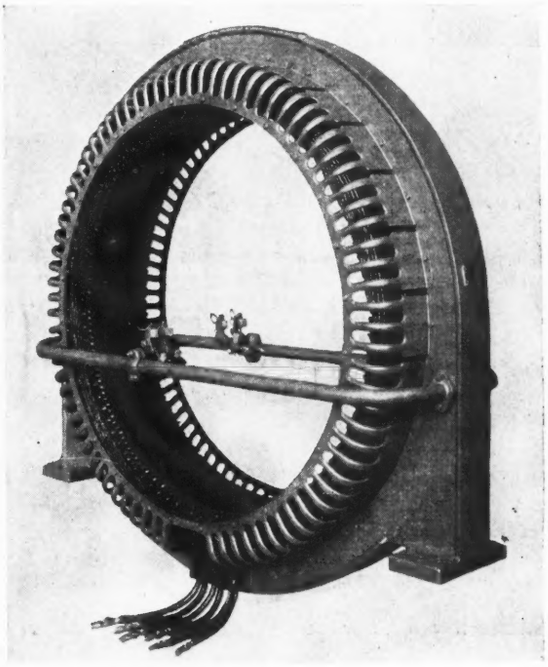


Fig. 8—Two-speed synchronous motor stator, with six leads brought out from the windings

vent any appreciable flicker of lights, especially in the operating room, and that they should be relatively quiet in operation.

In this installation the difference in demand on the refrigerating system between winter and summer made part operation desirable. The compressors are standard, of a size not furnished with clearance pockets; therefore unloading by speed reduction was the best solution. The two motors are rated 50 and 25 hp., 257 and 128.5 r.p.m., 0.6 and 0.5 leading power factor, 208 volts, 3 phases, 60 cycles and 50 deg. rise. The hospital power plant is too small to permit throwing either of these motors on full-voltage without serious light flicker, especially with only one generator operating. An increment starter is therefore employed, two steps of resistance being cut out with considerable time delay between them before connecting the motors on full voltage. This allows the generator regulators to act to maintain fairly constant voltage.

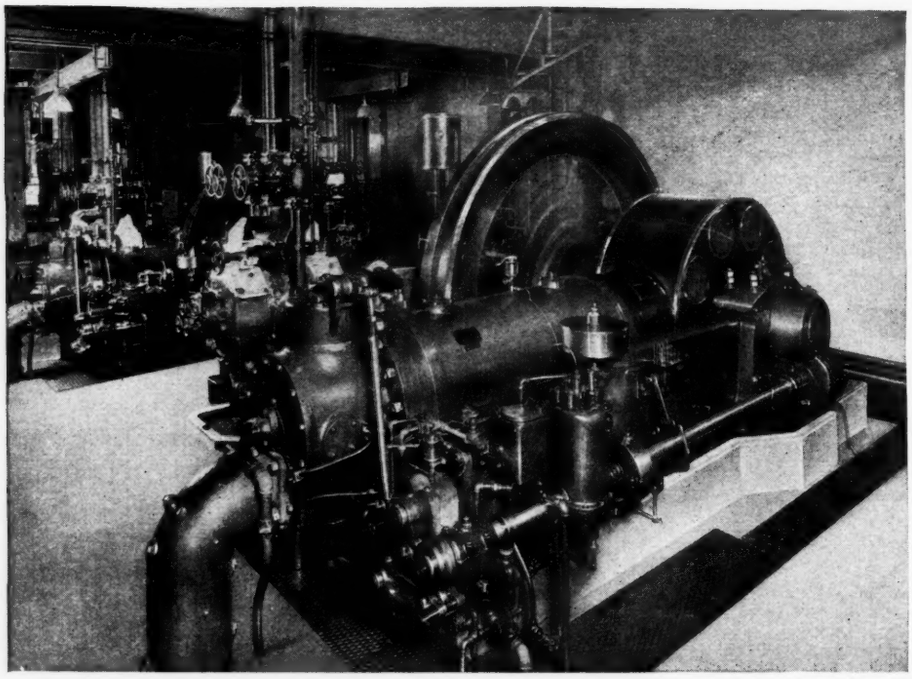


Fig. 1—A horizontal engine and a compressor with a single shaft and overhung cranks

Diesel Engine Drives for Refrigerating Plants*

By OTTO NONNENBRUCH and C. R. NEESON
I. P. Morris & De La Vergne, Inc.

Purchasing an efficient prime mover is not enough to insure efficiency — the installation must be correct. This problem, in so far as it relates to the connection of the engine to the machine, is discussed by the authors, who have had an extensive experience in engine and refrigerating practices.

SEVERAL FACTORS enter into the selection of oil engines and ammonia compressors for any specific plant. In some plants the question of driving the ammonia compressor is the only problem presented, whereas in other cases provision must be made for driving the auxiliaries, in addition to the compressor.

Sometimes all the auxiliaries are driven by their separate electric motors, in which event it may be necessary to install a generator on the oil engine shaft. In other cases, certain auxiliaries may be driven from the engine by means of a belt, or several auxiliaries may be belt-driven by a lineshaft.

A method of connecting horizontal engines to horizontal compressors is shown in Fig. 1, where a single-cylinder compressor is directly connected to a single-cylinder engine. The necessary flywheel effect is incorporated in the flywheel between the two machines, and the cranks for both the compressor and engine are shrunk on the shaft ends and no couplings are required.

The simplest method of installing a horizontal compressor driven by an oil engine is to shrink the compressor crank on the end of the oil-engine shaft, which is extended to receive the crank. No couplings are necessary or desirable in this type of drive, as there is only one bearing on the compressor.

In this type of installation the flywheel could be replaced by a suitable generator, with a small auxiliary wheel for driving an exciter set by means of a belt.

A customary method of connecting vertical engines and vertical type compressors is shown in Figs. 2 and 3, an arrangement with an outboard bearing to help support the engine flywheel, and a flexible coupling between the compressor and engine outboard bearing. Two compressors driven by a vertical oil engine, one

*Abstract of paper presented before the National Association of Practical Refrigerating Engineers, Memphis, Tenn., Nov. 12, 1930.

compressor at each end of the oil engine shaft, as in Fig. 4, is an arrangement sometimes adopted.

The vertical engines offer certain advantages for ammonia compressor drive where auxiliaries are required. If a compressor only is to be driven by the engine, enough cylinders to supply the required power are used on the engine. If auxiliary power generation must be allowed for, it is only necessary to select an engine of sufficient cylinders to take care of the total load. In Fig. 2 is shown an installation where a direct-current generator is belt-driven from the engine flywheel and the compressor is coupled to the extended shaft.

The present-day design of ammonia compressors permits maximum speeds, in the neighborhood of 400 r.p.m. in the smaller sizes. Engines may be obtained to operate at this speed, although slower speeds are the usual practice. This often makes it difficult to find an engine of suitable power and speed to fulfill the exact compressor requirements, and it is therefore sometimes desirable to connect an engine to a compressor by belt drive.

Where belt drives for the auxiliaries are not desirable, it is often possible to install a separate engine and generator set to take care of the auxiliary loads. This set can then operate at the constant speed best suited to the generator, and the engine and compressor unit run at any speed to suit the requirements of the refrigerating load. It is sometimes desirable to drive only a generator by the engine and have all compressors and auxiliaries motor-driven.

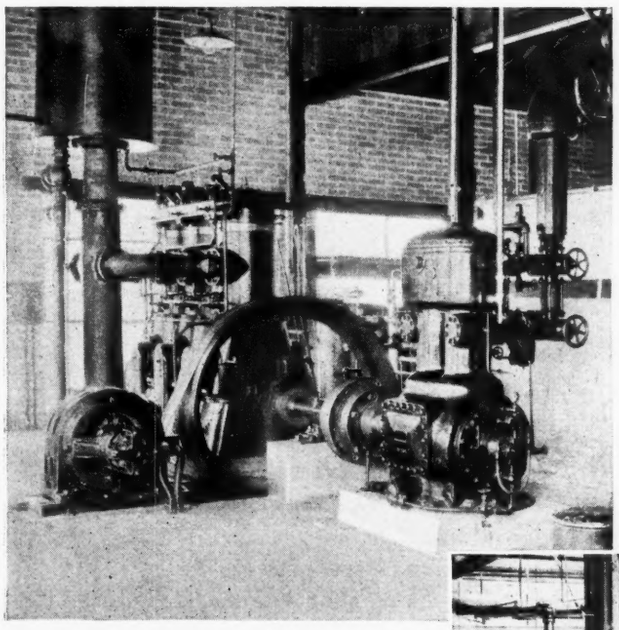


Fig. 2—A direct-connected compressor, and a generator belt-driven from the engine flywheel

When a generator is either directly connected to or belt-driven from the engine shaft, it is often necessary to run the engine at constant speed in order to hold up the voltage on the generator; but it is desirable under certain conditions of reduced refrigerating load to reduce the capacity of the compressor. The best method of reducing the capacity of a compressor under constant load is by means of clearance pockets. With such pockets, the clearance of the compressor can be increased, thus reducing the volumetric efficiency of the compressor, with consequent reduction in capacity. Clearance pockets on horizontal compressors have been standard practice for a number of years, but on vertical compressors they are only a recent development.

Variable-Capacity Machines

When an engine drives an ice machine that does not have clearance pockets, or that does have clearance pockets and unloads in steps, closer regulation of capacity can be secured by adjusting the speed of the unit to unit. Engine governors to do this are entirely practicable, and may be used where required. There is, of course, a minimum speed below which the engine will not run.

It is necessary in this case, of course, to use a variable-speed direct-current generator if electric power is to be obtained from the main unit. Such generators are obtainable for a speed range from maximum down to about 70 per cent of maximum.

The maximum horsepower that a compressor may require under any operating condition, compared with its horsepower under normal operating conditions, is a factor that must be carefully considered when driving ammonia compressors by oil engines.

Oil engines are not recommended for overloads, even for short period of time. The engine should, therefore, be of sufficient power at its normal rating to drive the compressor under any load that may be imposed upon it. The mean effective pressure of an ammonia compressor will vary from 80 to 0, depending upon the conditions of operation; that is to say, back pressure and head pressure. If a refrigerating plant is shut down and the back pressure and discharge pressure are equalized, when the plant is again put in operation the compressor will go through a period of maximum horsepower requirement due to the high discharge pressure caused by insufficient condenser surface for the increased compressor capacity at high suction pressures. If this condition is likely to exist for any length of time, the engine must have sufficient power to drive the compressor at maxi-

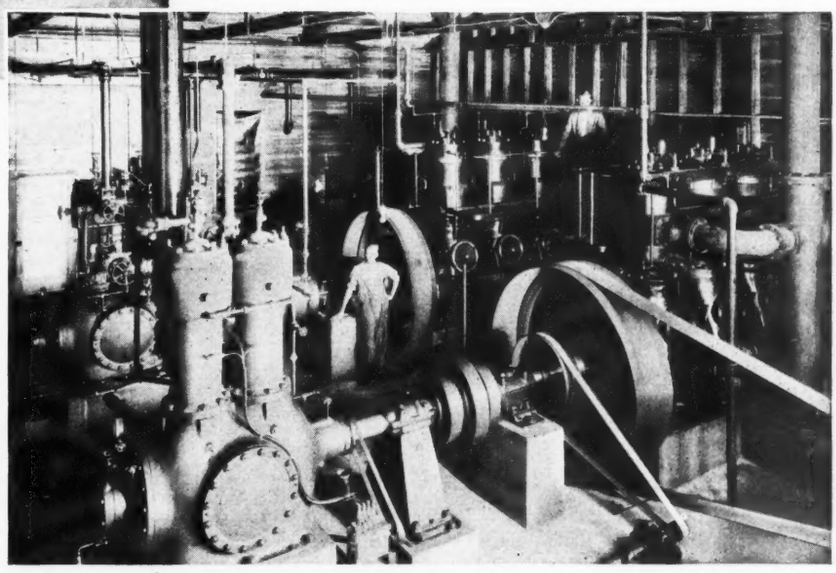


Fig. 3—An arrangement similar to Fig. 2, except that a long belt drives the generator

mum horsepower conditions. On the other hand, an ice plant operates during the greatest part of the year at its normal rating. In this case, an engine of horsepower just slightly in excess of the normal load may be supplied, and in the cases of shutting down and restarting, the operator may adjust his stop valves so that the suction pressure does not become excessive and the load on the engine does not go above normal rating.

Avoiding Vibrations

It is well known that high-speed machinery is, for any given capacity, less expensive than slow-speed machinery. This is very true of diesel engines and ice machines. Consequently, it is frequently more economical to install relatively high-speed vertical engines. Such engines may or may not set up soil vibrations, depending upon several factors. The number of cylinders is one of the most important of these.

The disturbing influences of vibrations are of two kinds, one of which tends to shake the engine in a vertical or a horizontal direction. The other tends to rock the engine longitudinally. The former is usually the more serious.

Single-cylinder engines are the worst as regards vibrations, and they should, consequently, not be run at high speeds. It will be noticed that single-cylinder engines are always rated at low or moderate speeds.

Two-cylinder engines with cranks in line are similar to single-cylinder engines as regards vibrations. This arrangement of cranks is frequently employed in four-stroke-cycle engines to obtain a more uniform torque than can be had with cranks set at 180 deg. Two-cylinder engines with opposed, or 180-deg., cranks have a characteristic rocking couple.

Three-cylinder engines have all forces balanced, but the couples are not. In general, they are not inclined to produce serious vibrations.

Four-cylinder, four-stroke-cycle engines, with the usual crank arrangement, have large unbalanced forces that are much inclined to give trouble. This crankshaft arrangement is similar to that found in four-cylinder automobiles. If trouble is feared from this source, a satisfactory solution may be had by arranging the cranks in two opposed pairs, the pairs being turned at 90 deg. to each other. This balances all the forces save a rocking couple.

Five-cylinder engines have their forces balanced, but have a rocking couple.

Six- and eight-cylinder, four-stroke-cycle engines are completely balanced, and where smoothness of operation is important they give the best results. Six-cylinder and eight-cylinder two-stroke-cycle engines are not quite balanced.

The ice machines themselves are not likely to cause vibration troubles, because of their relatively low piston speeds.

Insulating the Foundations

Correct foundation design can do much to reduce or eliminate vibration. For instance, it is sometimes desirable to insulate the foundation from underlying rock or concrete mat by means of cork sheathing. This cork may be some three or four inches thick at the bottom, and is carried around the sides of the foundation with somewhat less thickness than at the bottom. The cork has the property of absorbing the high-frequency vibrations, and cork has been used with conspicuous success in a number of instances where vibration would not be tolerated.

In any case, it is important that no building wall footing or column rest upon or touch the engine foundation. Any vibration that exists would then be transmitted to the building. Not less than 6 in. of dry earth should separate those parts of the building from the foundation.

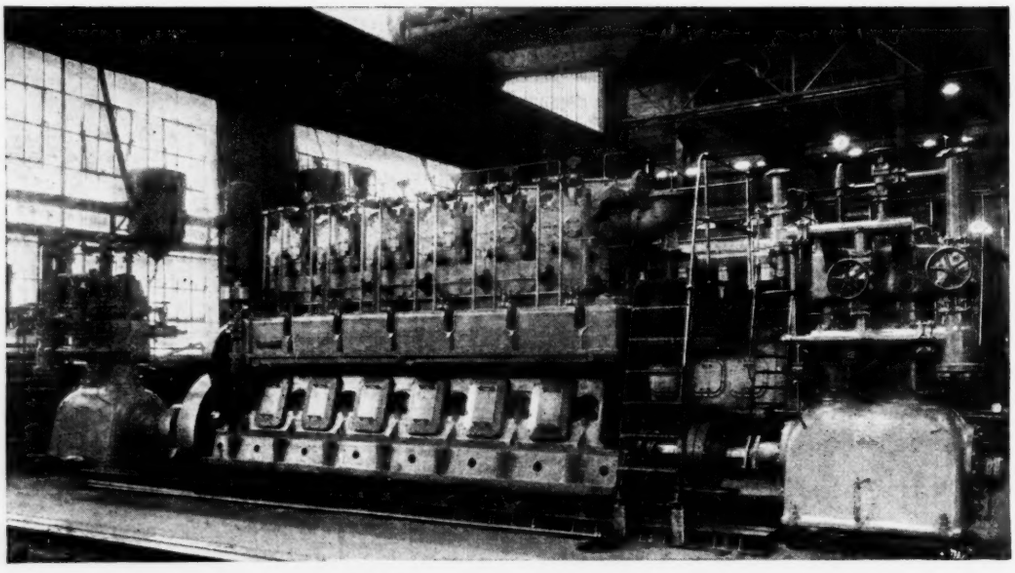
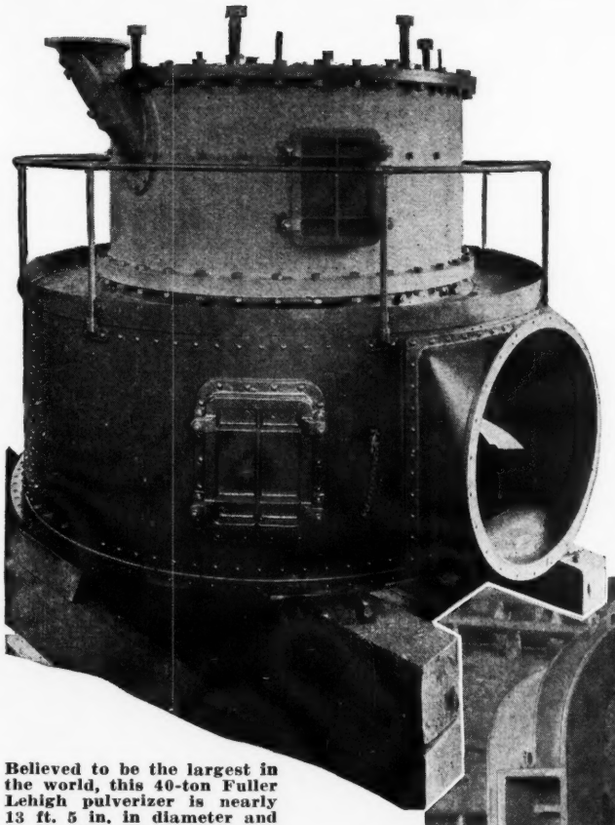
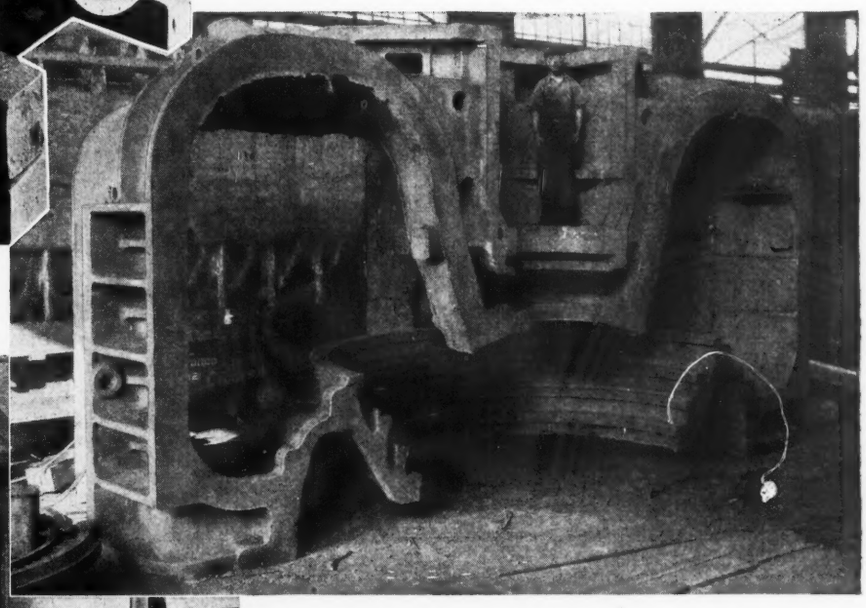


Fig. 4—Engine drives two direct-connected compressors, one of which has clearance pockets for capacity control, while the other compressor handles two suction pressures

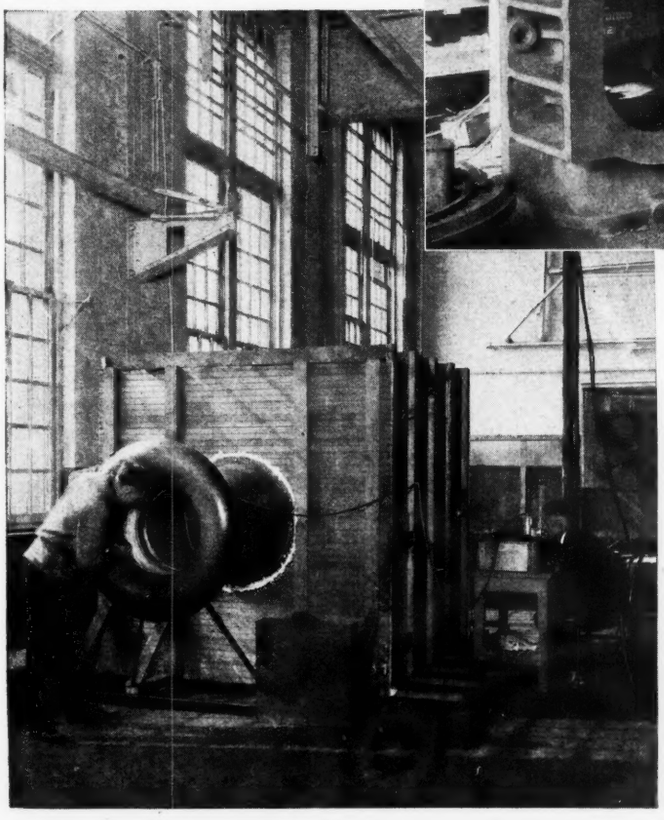
Power Engineering INNOVATIONS



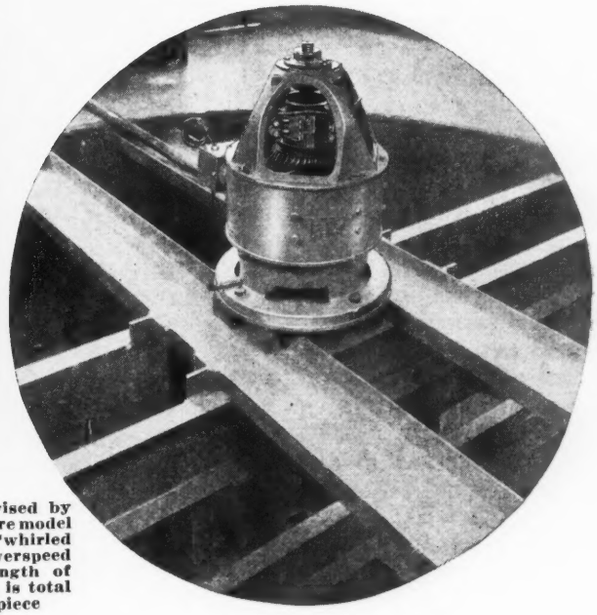
Believed to be the largest in the world, this 40-ton Fuller Lehigh pulverizer is nearly 13 ft. 5 in. in diameter and 15 ft. high. It is being installed in the Kips Bay Station of the New York Steam Corporation



A giant casting which is half of the lower half of an exhaust hood for a 160,000-kw., tandem-compound, double-flow steam turbine-generator being constructed at the General Electric works in Schenectady



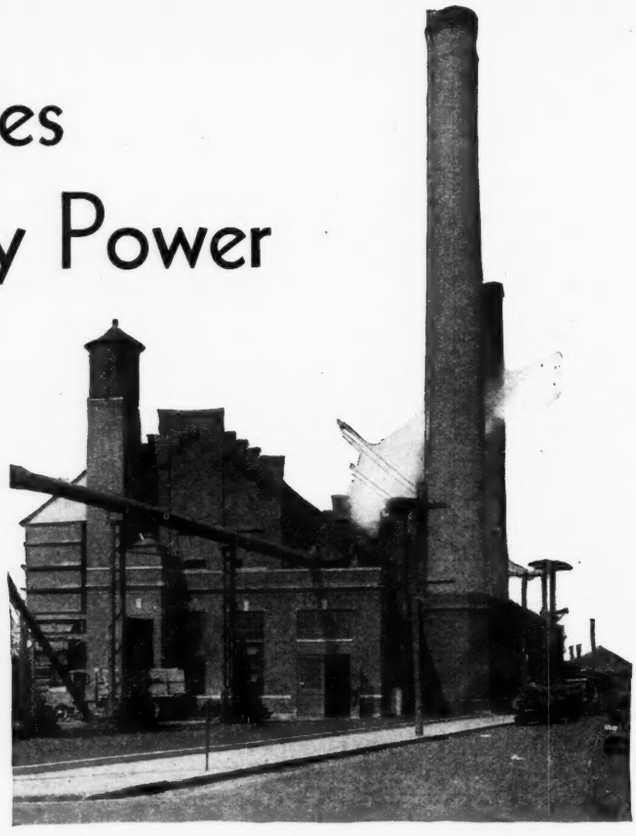
Applying aviation principles, this "wind-tunnel box," set up in the Westinghouse works at East Pittsburgh, finds by test the efficiency of various types of fan blades designed on the "air-wing" theory



A unique "torture pit," devised by Westinghouse engineers, where model turbine rotors are literally "whirled to death"—not as an overspeed test to determine the strength of the steel but one whose aim is total destruction of the test piece

Incinerator Generates Own Auxiliary Power

By W. S. DYGERT



Paterson's refuse and garbage is disposed of in this plant, located near the center of the city

WITHIN the last two decades city engineers have ceased to look at garbage as a necessary evil with no possibilities. The same expert engineering knowledge that has made American city water-works, super highways and municipal building programs the envy of the world is now being employed on this former public nuisance.

Yesterday the keeper of the garbage dump was an outcast in local society; today the supervising engineer of the city garbage disposal plant is a respected citizen—in many cases a university-trained engineer who knows his B.t.u.'s and thermodynamics.

There are many interesting examples of what municipal refuse disposal has done for American cities. Perhaps one of the most interesting is to be found in the city of Paterson, a north New Jersey manufacturing town of 140,000 people. Twenty years ago the garbage of that city, as in most others of the same size, was carted to the city dump, where it lay in unsightly piles, infested with rodents—a menace to small children.

Garbage was a serious problem in Paterson. Complaints were piling up. Property values in the vicinity of the dumps were falling. Block after block of good city property was becoming worthless because of its proximity to the city dump. Paterson, too, in its strides of progress was expanding, and soon had spread so that the garbage dump was almost in the center of town.

The best engineering skill was called upon to cope with the problem, and from a burning problem figuratively, it became a burning problem literally. The engineers decided to erect a 60-ton $100,000 garbage incinerator at the dump and burn Paterson's garbage. The cost was more than justified by the tremendous increase in property value in that section of the town after the incinerator was put in operation. As a matter of fact, the increase in property value more than equalled the entire cost of the installation.

So successful was the venture, that in 1929, when the town had outgrown the 60-ton incinerator, there were no objections raised to increasing the plant by adding an improved type 200-ton incinerator.

Today there is no noise, smoke or odors about the plant. Located in the geographical center of the city, the garbage haul is short and therefore economical, and residences and stores of the better type are found almost adjacent to this great garbage burning plant.

One might question how the hundreds of truckloads of garbage could so successfully and unpretentiously disappear into nothing, until an inspection of the plant had been made.

First, the receiving pits are inclosed by mechanically operated doors. There is a ventilating system with a capacity of 75,000 cu.ft. of air per minute. This draws all air odors and foul gases from the pits and buildings and exhausts them through an air washing and chlorinating system, which, when it has finished with the air, exhausts it in a practically odorless condition.

Garbage collections are made from 7 a.m. to 3 p.m. and the garbage picked up is immediately dumped into the 75-ton receiving pits, where electric cranes with grab buckets transfer it to the charging floors above the furnaces. Here, before burning, provision is made to separate the rags and other material of value. This is later sold. The combustible portion of the refuse, such as wooden boxes, paper, etc., is stored to furnish extra heat for the furnaces on wet days, when the incoming garbage is damp and difficult to ignite.

Municipal refuse as received at the incinerator consists principally of garbage and rubbish. Garbage ordinarily weighs 30 to 45 lb. per cubic foot, and may have a gross heating value of 1,500 to 2,000 B.t.u. per pound. It also may have as high as 90 per cent moisture, although in ordinary garbage the average is 65 to 75 per cent. The rubbish content of municipal refuse, consisting of wooden boxes, paper, cardboard, etc., weighs from 3 to 20 lb. per cubic foot and may have a gross heat value of 6,000 to 8,000 B.t.u. per pound. As the city's refuse runs about 65 per cent garbage and 35 per cent rubbish, there is generally enough rubbish to furnish

sufficient heat to dry out the garbage so it too will burn easily without the use of auxiliary fuel.

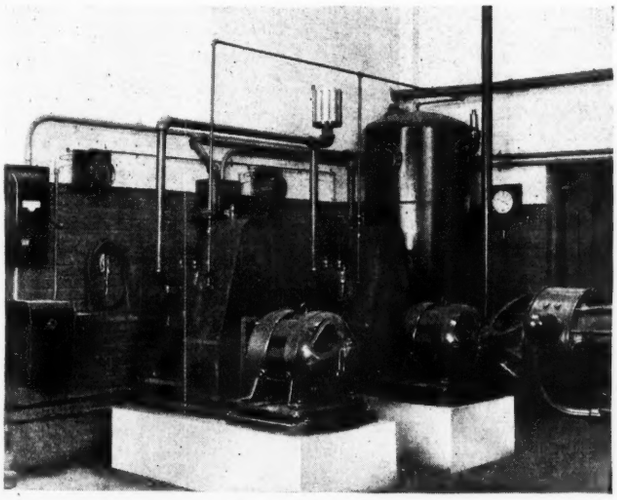
It is interesting to note that no fuel is purchased at any time at the Paterson plant, even during the heavy winter snows. Other plants not so fortunate in having a supply of dry rubbish on hand at times are forced to burn fuel to help out. In fact, some types of garbage incinerators are equipped with oil burners for just such occasions.

The incinerators are fed from the top through charging holes. Part of the moisture in the garbage evaporates during the handling from the receiving bins to the charging floor above the furnaces. What moisture is left is driven off in the furnace. The Paterson incinerators have a drying hearth inside the furnace, where the wet garbage, after coming through the charging hole, is allowed to remain until it has dried out enough to be raked down on the fire and burned over grates.

Continually changing temperatures and the formation of glass slag from the content of the refuse is hard on firebrick. Ordinary commercial firebrick is generally short-lived under these firing conditions.

The ash encountered in municipal refuse incineration varies from 1 to 25 per cent and includes some clinker and glass slag. Tin cans also come through the incinerator, although after being subjected to the heat of the furnace they are in a condition to deteriorate rapidly once they reach the municipal ash dumps.

When garbage is heated, odorous gas is given off. The most obnoxious of these occur below 800 deg. F. When



Various auxiliary equipment is operated by compressed air from these units

the proper mixture of air and gas is obtained, a temperature of 1,200 deg. will consume the gas completely and assure no odors escaping from the plant.

At the Paterson plant forced draft is used, and a temperature of 1,600 to 2,200 deg. is maintained within the furnace, which is more than sufficient to destroy all odors. That this is successfully done is evidenced by the fact that the incinerator is located in a business and residential section.

The hot gas from the burning garbage is baffled through an Edge Moor water-tube 4,090-sq.ft. boiler, which generates 200-lb. steam at no extra operating cost. The steam is used to operate a General Electric turbine generator, which supplies light and power for the entire plant. Part of the power goes to operate three Chicago Pneumatic air compressors, which furnish compressed air for operating such mechanical devices about the plant as the heavy steel doors over the receiving pits, hoists, etc.

Although all dust was taken care of within the plant, there seemed no may to keep the loading platform dust from finding its way into the compressor room, where it got in the moving parts of the air compressors and after a time caused the valves to stick and cylinders to wear. To overcome this menace, the compressors were equipped with Protectomotor air filters, which catch all this dust and grit and deliver clean air to the compressor. In the furnace room and main plant ashes and clinker are removed by means of a 12-in. pneumatic conveyor in which a vacuum of 6 in. is maintained by a suction blower driven by 150-hp. motor. Thus no dust menace is encountered in the plant itself.

The entire Paterson plant is practically dustless and noiseless in operation so far as the outside neighborhood is concerned. A stranger passing the plant, if it were not for the trucks unloading, would imagine that the incinerator was not in operation.

Capacitors Correct Power Factor of Neon Signs

By C. C. NELSON

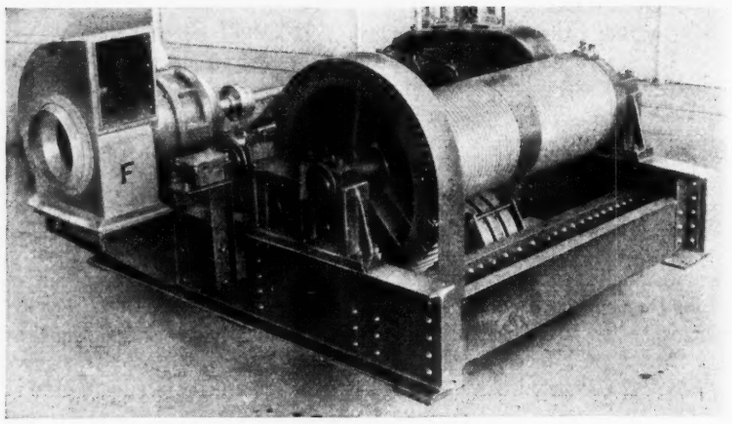
Engineer
Electric Machinery Mfg. Co.

THE INCREASING popularity of Neon signs, which operate at power factors of from 45 to 50 per cent, has attracted the attention of power companies and caused much concern about their low power factor. Neon signs operate at a high voltage usually obtained from the secondary of a 110- to 15,000-volt transformer. The high leakage reactance of such a transformer causes the current to lag behind the voltage, resulting in poor power factor.

While a few such signs would not seriously affect the factor of a large power system, the density in business sections is often so great that signs may number 1,000 or more. There the effect on the power factor of the system is appreciable, often making it necessary to increase generator and feeder capacity to supply the load. In many instances, the power companies have found it necessary to protect themselves by requiring sign users to employ some means of power-factor correction.

An instance of such action is that recently taken by the Portland General Electric Company, Portland, Ore. This company, after a survey of conditions, announced that after Sept. 1, 1930, all Neon signs to be installed on their lines must have power-factor correction equipment. A capacitor connected across the low-voltage terminals of the transformer counteracts the effect of the transformer reactance by supplying reactive power which otherwise would be drawn from the power lines. This improvement of power factor materially reduces the load on generators and feeders. The sizes of capacitors necessary to correct the power factor of small store window signs ranges in rating from $\frac{1}{4}$ to 1 kw. Larger display signs necessarily require capacitors of higher rating. Capacitors for this service, to have long life, must be substantially constructed and liberally designed to withstand overvoltage surges.

FAN Controls Lowering Speed of Gate Hoist



Fan for controlling the lowering speed of the hoist is shown at *F*

A fan connected to the hoist-motor shaft controls the lowering speed of penstock intake gate 29 ft. 7 in. high x 12 ft. 6 in. wide

By FRED NEWELL
Mechanical Engineer
Dominion Bridge Company, Ltd., Montreal

THERE have recently been completed eight gate hoists for the Chute-a-Caron development of the Alcoa Power Company, Ltd., a subsidiary of the Aluminum Company of America. This development is on the Saguenay River, near Racine, Quebec. The hoists are for handling the gates at the turbine intakes, which are 29 ft. 7 in. high x 12 ft. 6 in. wide. They are of the fixed-roller type, for a maximum head of about 67 ft. at the sill, as indicated in the drawing on the opposite page.

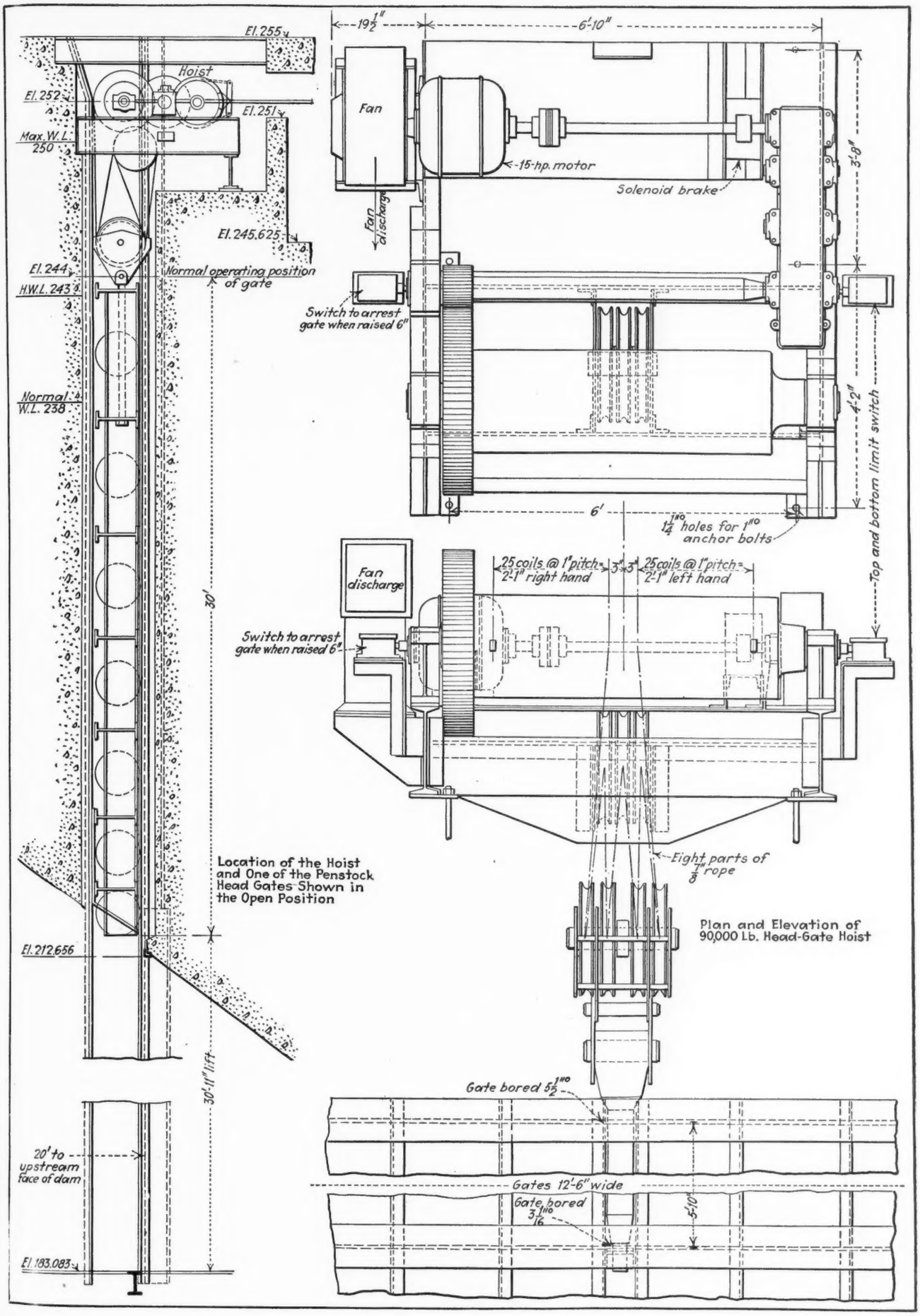
The hoisting arrangement is of the conventional type, consisting of a motor connected by spur gearing to a drum that lifts the gate on a number of falls of wire rope. A solenoid brake on the motor holds the gate in any lifted position. A ratio of lowering speed to hoisting speed of 3 to 1 is used, the actual figures being 9 and 3 ft. per minute, respectively.

Gates of this type must always be fast-lowering, so that the water may be shut off quickly should an accident occur to the turbine or generator. Consequently, that part of the hoist which controls the speed of lowering is of extreme importance. It must act instantaneously when called upon and must not require much attention, or neglect may render it inoperative. Lowering may be accomplished either by electrical or mechanical braking, a centrifugal brake which limits the lowering speed to a predetermined value commonly being used.

In this case it was suggested by the purchaser to the Dominion Bridge Company, the builder of the hoists, that lowering be controlled by means of a centrifugal fan or blower. At first thought this may seem impossible, but an analysis of the factors involved will reveal that such control has many desirable features. It not only has the advantage of being economical, the fan being comparatively inexpensive, but is entirely independent of frictional coefficients, on which all types of mechanical brakes are based. Furthermore, a mechanical brake absorbs energy by transforming it into heat, and must be designed to meet these conditions, whereas the heating of the air in the fan is negligible. Another advantage of the fan is that, as its speed changes, the horsepower required to drive it varies as the cube of the speed, giving a sharply rising curve. This is a desirable characteristic because the power may vary considerably without materially changing the speed, and thus small errors in calculating the gate's weight and its friction has little effect on the final results.

Standard fans, naturally, are made as efficient as possible. But for controlling a gate's lowering speed, a fan should be inefficient, so that the horsepower absorbed will be as large as possible to keep down the fan's size, the amount of air delivered not being of any consequence. A satisfactory design was developed to which the hoists were built. Shop tests were made, actual load conditions being duplicated as closely as possible. Results obtained were practically as anticipated, small inaccuracies being compensated for by slightly restricting the fans' discharge openings by a permanent damper. The fans were found to be extremely sensitive to any restriction of the inlet or discharge openings, and both must be kept free of obstructions.

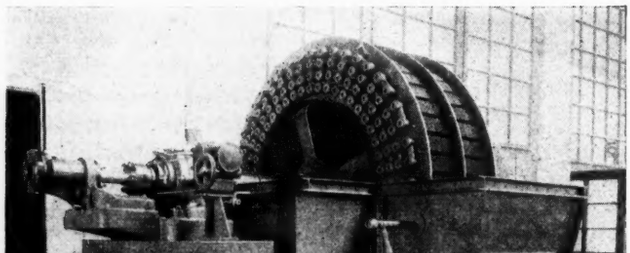
Another interesting feature of the hoists is that the gates may be lowered by remote control from the power house switchboard room. This is accomplished by a special solenoid brake having a second solenoid actuated by a source of power separate from the remote push button. The gate may be lowered locally by simply reversing the motor, under which condition the lowering speed is slightly in excess of 3 ft. per minute. The hoist has a geared limit switch to control the distance of travel at the top and bottom positions. When opening, a second limit switch stops the hoisting motion when the gate is 6 in. above the sill, at which point a halt is made until the penstock fills. This limit switch may then be shunted out by a push button and the hoisting continued. Capacity of the hoist when lifting is approximately 90,000 lb. The lowering load, which is the weight of the gate in water, is about 40,000 pounds.


El. 255
Hoist
El. 252
El. 251
Max. W.L. 250
El. 245.625
El. 244
H.W.L. 243
Normal operating position of gate
Normal W.L. 238
30'
El. 212.656
30'-11" lift
20' to upstream face of dam
El. 183.083
19½"
6'-10"
Fan
15-hp. motor
Solenoid brake
Fan discharge
Switch to arrest gate when raised 6"
3'-9"
4'-2"
Top and bottom limit switch
6'
1¼" holes for 1" anchor bolts
Fan discharge
25 coils @ 1" pitch = 2'-1" right hand
3"
3"
25 coils @ 1" pitch = 2'-1" left hand
Switch to arrest gate when raised 6"
Eight parts of ⅞" rope
Location of the Hoist and One of the Penstock Head Gates Shown in the Open Position
Plan and Elevation of 90,000 Lb. Head-Gate Hoist
Gate bored 5½"
Gates 12'-6" wide
Gate bored 3 1/16"
5'-10"

The Rotating Economizer

By ARNOLD WEISSELBERG

Consulting Engineer
Jersey City, N. J.



The Simmon rotating economizer (patented) is an interesting foreign development

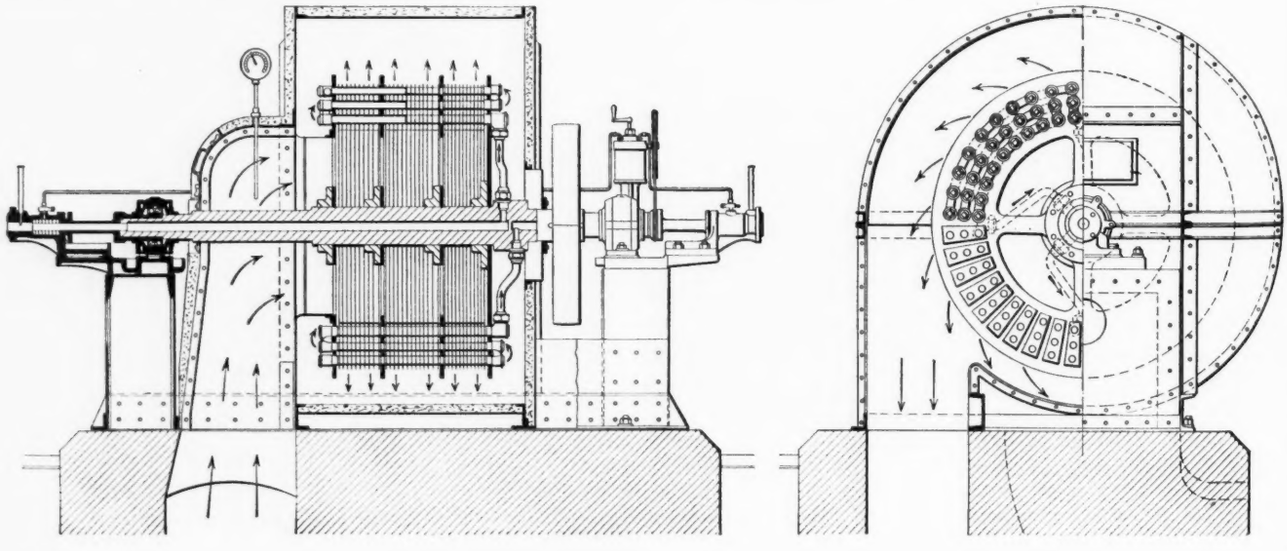
UNCONVENTIONAL designs are likely to attract the attention of almost any engineer. Quite often the knowledge of them will aid him in handling unusual conditions where conventional designs are inadequate.

Any one looking at the picture in Fig. 1 would hardly suspect it represented an economizer. Fig. 2 depicts its construction. The cold water enters at the left end of the hollow shaft, taking its course as indicated by the arrows and leaves at the right end of the shaft. The path of the flue gases, as seen in the side view in Fig. 2, is counter to the flow of water, thus assuring low exit-gas temperatures. The gases are forced through the small spaces between the tube disks, in this way attaining the high velocities required for high heat-transfer rate. This has the additional advantage of forestalling the deposition of soot and fly ash, although a soot blower is provided for occasional cleanings. The extended surface disks are collared, providing spaces and at the same time preventing contact of the flue gases with the copper tubes. The tube caps are plugged opposite the tubes to permit of inside cleaning of the tubes.

The rotating economizer has in the course of the last five years found application in about fifty power plants abroad. In most instances the need for this economizer arose from the limited space and draft conditions, on the one hand, and a desire to improve the efficiency of the plant by use of an economizer, on the other. The design is such that a slight surplus of draft is created with the economizer in operation, so that not only is no additional draft required to operate this economizer, as would be the case with one of the stationary type, but it will also increase the draft at the boiler exit, resulting in a slight increase of boiler capacity.

The cost of such an economizer is somewhat higher than that of a stationary economizer of equal capacity, but the saving in space and the reduced cost of installation may, in certain circumstances, more than offset the higher price and justify its installation.

Rotation forces the gases between the fin tubes



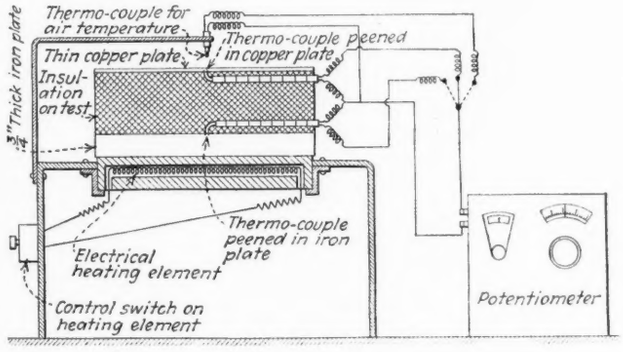
...RIGHT OUT OF THE PLANT...

Practical Test for Heat-Insulating Value of Materials

THERMAL economy in the modern power plant requires that all hot surfaces be insulated. One of the chief characteristics to consider is the heat-insulating value of the material used.

The sketch shows a simple but practical apparatus for determining the heat-resisting quality of insulating materials. The material to be tested is placed between a $\frac{3}{4}$-in. iron plate and a thin copper plate. Each of these plates has thermocouples peened in the metal on the insulation contact surfaces, which, when connected to a potentiometer, give surface temperatures of the insulation.

Heat is applied to the $\frac{3}{4}$-in. iron plate by an electrical heating element. The insulation contact surface of the $\frac{3}{4}$-in. iron plate is held at a fixed temperature, similar to that which may be expected on a job, by a control switch on the heater. It is best to maintain this condition for several hours to insure that the material is thoroughly dried and general conditions, such as heat transfer and radiation, assume a fixed point. When it is evident that conditions are steady, a series of ten or twelve readings should be taken, at five-minute intervals, on (1) hot metal surface temperature, (2) cold metal surface temperature, and (3) surrounding air temperature. These readings are averaged and the insulating efficiency is determined by the following formula:



Details of apparatus for testing insulating materials

$$Ins.\ eff. = \frac{Hot\ surface\ temp. - cold\ surface\ temp.}{Hot\ surface\ temp. - surrounding\ air\ temp.}$$

One grade of insulating material showed the following:

	Deg. F.
Hot surface temperature	700
Cold surface temperature	150
Surrounding air temperature	100

$$Ins.\ Eff. = \frac{700 - 150}{700 - 100} = 91.8 \text{ per cent}$$

When making tests to compare various insulating cements, care must be exercised to make all samples of uniform thickness, and if plastic material is used a fixed water-cement ratio should be employed and the sample should be thoroughly dry before temperature readings are taken.

Tests can be made with this apparatus to determine the insulation efficiency of various kinds of insulating cements, and it is also possible to predetermine the thickness of insulation required to give a fixed exposed surface temperature when the hot surface temperature is known.

M. D. DAWSON.

St. Louis, Mo.

Advantages of Thin Fires and High Induced Draft

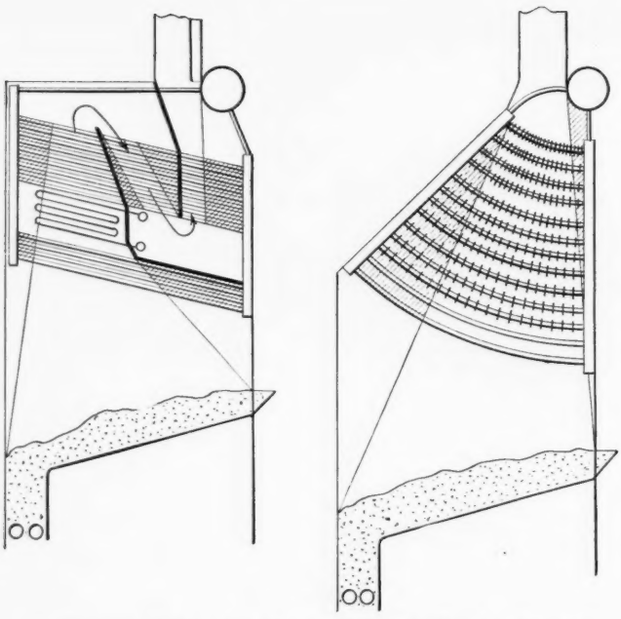
WITH REFERENCE to the article of Bert Houghton in the Sept. 3, 1930, number, on the "Advantages of Thin Fires and High Induced Draft," I agree with him as to the advantages of thin fires but do not agree with him as to the merits of high induced draft.

For several years I have advocated the use of thin fires with multiple-retort stokers. This, of course, is contrary to the general practice advocated by many manufacturers of this type of stoker.

It is my opinion that there are some serious disadvantages to the use of thick fuel beds. With thick fuel beds, practically the same chemical reactions take place as with blast furnaces, that is, the CO_2 formed in the region of the tuyères when passing through a thick bed of burning coke is changed to CO.

Part of this CO might be burned after the first pass through the bank of tubes, but nevertheless the result is a lessening in efficiency. At first the formation of CO in the furnace lessens the furnace temperature, which results in a smaller difference of temperature between the furnace and the bank of tubes, hence, in a smaller exchange of heat to these tubes. Moreover, relighting of this CO, which might happen while passing through the tubes of boilers, causes a higher temperature of the gases at the boiler outlet.

These troubles are eliminated with thin fires; but it is necessary that the fuel bed be uniform in thickness throughout the entire length of the retorts. The necessity of a uniform fuel bed was realized more than eighteen years ago, as evidenced by the use of stepped



Diagrammatic sketch (left) showing reduction in effective heating area with high induced draft, and sketch (right) of Rauber single-pass boiler

secondary pushers forming support of the fuel bed (described in my U. S. Patent No. 15462). But these old devices are not sufficient to give a porous fuel bed with modern underfeed stokers of the multiple-retort type.

In fact, as clearly told by Mr. Houghton when speaking of the blacksmith's forge, it is necessary to poke and break up the fuel to eliminate the troubles he pointed out. This is what I have endeavored to accomplish automatically and continuously by the use of certain new and improved devices for underfeed stokers. The application of these devices to old stokers at the French super power plant Gennevilliers has given good results and seem to have proved the correctness of the principle.

Relative to the advantages of high induced draft, no doubt it has the advantage of giving to the gases a higher velocity and consequently may give a better transmission of heat between the gases and the heating surfaces of the boiler. But it is my opinion that it tends to short circuit the travel of the gases through the boiler and reduce the effective heating area—not to mention the necessity of having air-tight casing and baffling.

The accompanying sketch indicates what in my opinion occurs with high induced draft, the hatched parts indicating the heating surfaces not being used.

I think that, to use a high induced draft to the best advantage, it is necessary to employ a specially designed boiler having no baffling at all and specially shaped to insure the utilization of all or nearly all of the heating surface. The new boiler of Rauber et Luquet would appear to meet this requirement, as indicated in the accompanying illustration, which shows the same stoker as illustrated by Mr. Houghton applied to this type of boiler.

Relative to the figures on the sketch presented by Mr. Houghton illustrating the draft conditions, and the results pointed out, it seems to me that it is rather difficult to draw a conclusion, because fuel bed conditions are so different. It would also seem that the variance in results was due more to the difference of thickness of fuel bed than to the type of draft used above the fires. It would be interesting if comparative tests could be made with the same conditions of thin fires in both cases; one with high induced draft and the other with balanced draft.

Until the proof of the contrary is established, I am of the opinion that, with the same conditions and thickness of fuel bed, better results must be obtained with balanced draft than with high induced draft. This opinion is based on the fact that with balanced draft a larger part of the heating surface is more effectively used than with high induced draft, and consequently it is as if heating surfaces, economizers, air heaters, etc., were added to the boiler.

MAURICE RATEL,
Paris, France. Foyers Automatiques Ratel.

Convenient Means for Anchoring Chain Hoist to I-Beam

IN DEFENSE of my article in *Power* in which I advocated the use of industrial chain links for suspending chain hoists from I-beams, I should like to add the following statements:

In the Nov. 4, 1930, number George W. Clark, who objects to "so flimsy a device," recommends the use of a forged clamp made from mild-steel flat-bar stock, but this involves the making of several sizes for various widths of beams and loads. The catalog at hand on industrial chains gives the working strength of 3.25-in. pitch chains as 18,000 lb. A safety factor of 4 or 5 would bring the breaking strength of a link to about 8,000 lb., or 4 tons. Of course, this is necessarily reduced because of the adverse arrangement of hook to link and link to I-beam. Inasmuch as the load is shared by two links, 2 tons would seem to be a conservative figure.

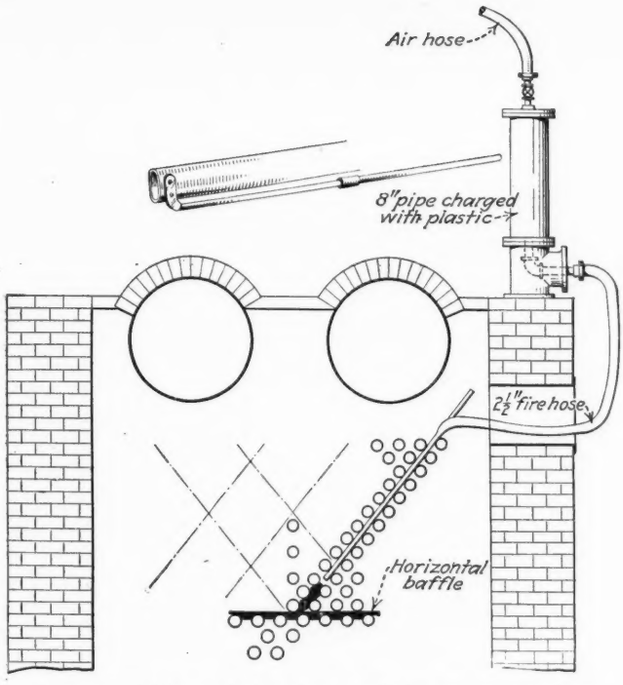
Obviously, no one is going to risk heavy machinery to anything but well-designed hoisting means. There was no attempt on my part to suggest the makeshift link in the place of a well-designed article. Nevertheless, woodworking machinery and motors not in excess of two tons have been successfully handled from I-beams of various sizes where it would have been costly to have made special clamps.

W. S. WHITING, JR.
Butler, Tenn.

Pouring Baffles With Plastic Material

ABOUT a year ago we put a vertical baffle in combination with a part-way horizontal baffle in one of our boilers so as to get more surface exposed to the radiant heat from the natural-gas-fired furnaces.

We tried several methods of putting in the baffle and failed each time, until we hit on the idea of using a 2½-in. canvas fire hose, which worked to perfection. A piece of 8-in. pipe about 3 ft. long with companion flanges on each end and blind plates, one of which had a pipe nipple threaded into it, were used in connection with an old 8-in. flanged tee. The whole rigging was stood on end on top of the boiler brickwork and the fire hose was connected to the pipe nipple through the side outlet of the 8-in. tee as shown. The hose was placed inside the boiler through the top inspection door near the baffle. The end of the hose was directed down to the



Arrangement for surfacing plastic baffle by means of fire hose

bottom of the baffle with a jointed rod that had one end flattened and bent at right angles and riveted to the end of the hose. With the lattice in place and the hose spotted, the plastic firebrick material was made to flow into place by turning on air at 100 lb. pressure.

The plastic material, which was well mixed and soft, but not so diluted as to allow it to segregate, flowed through the hose and filled every space around the boiler tubes. By moving the end of the hose to new locations, the whole baffle was made in a few hours.

Care has to be exercised when nearing the top of the baffle, for when the material has all passed out of the hose the air will rush out and splatter the material considerably.

These baffles have been in use about a year and are perfectly tight. W. F. SHUTT.

Laredo, Texas.

False Economy in the Power Plant

IN PLANNING to attain maximum economy with an installation of steam boilers, accurate metering of the feed water is a consideration of the first importance. Realizing this, the engineer in charge of the power plant of a large manufacturing works decided to install a meter in the main feed-water line, specially designed for this service. The establishment had a purchasing agent whose working knowledge of practical engineering was limited, but who nevertheless was given full scope in the purchase of equipment and supplies for the power plant. It seemed to him that the cost of the meter the engineer recommended was too high.

There are several forms of water meters on the market, but all are not suited to service in a feed-water line. The purchasing agent disregarded this important fact. He hinted that meters of the disk, rotary and piston types were comparatively low in price and easy to install. The engineer objected on the ground that they lacked the refinements necessary in a water meter operating under high and widely varying temperatures; but he was overruled. As an accurate gage of the quantity of hot feed water flowing, the meter that was put in was a distinct failure, although it undoubtedly would have told a true story had it been passing water at an ordinary low temperature.

A change in the administrative personnel of a big industrial institution was followed by drastic changes in the management of the power plant. No longer was the chief engineer given *carte blanche* in choosing and distributing the supplies. The new management figured that two gallons of oil per eight-hour watch was sufficient for each of the engines. And so it was, if all went well. But if a bearing got warm and the oiler had to give it an extra dose of oil, he would be compelled to starve all the other bearings to make his two gallons last. After a few bearings had to be rebabbitted because of overheating, at a cost many times exceeding the saving in oil, the management let the chief engineer have his own way in the matter of lubrication.

The purchasing department of a company owning a line of steamboats resolved to introduce new economies in the engine rooms. Under the engineering department's expert supervision, a first-class grade of packing, cut in rings to fit the rods and stuffing-boxes, had been selected. The packing was expensive, but the resultant freedom from wear and tear more than offset the high price. The chief of the purchasing department could not appreciate this, however. It seemed to him that many dollars would be saved by getting a cheaper brand of packing. The new packing worked all right for a brief period; but not having been designed to withstand the high heat and pressure of the service, it soon vulcanized and became hard, brittle and abrasive. Scoring of the rods and blowing of steam from the stuffing boxes became chronic, and nearly double the former quantity of packing was used, entailing an expense that far exceeded the price paid for the high-grade material. At the end of two years all of the rods on the auxiliary engines had to be turned down and the stuffing boxes bushed, while the rods on the main engines were so badly scored that keeping them tight was next to impossible, even after the better quality of packing had been restored.

This misguided striving for economy, whereby a saving of a dollar in a transaction today may lead to a loss of two dollars tomorrow, is not a rare phenomenon in power plant management. It would be such, however, if the purchase and distribution of packings, oils and other supplies was always left solely to the discretion of a competent chief engineer, the man who knows best the actual conditions and requirements of power plant service.

Economy has been defined as the spending of much when much is needed, little when little is needed, and nothing at all when nothing is needed. In their ill-considered efforts to make a creditable showing at the end of the year, these pseudo economists will cut down the operating force and skimp and pare in the use of materials until a rundown condition develops that will cost far more to remedy than any sum that might be realized from such penurious management. The law of averages holds the same in this as in all human activities. Efficiency and economy are not synonyms for niggardliness. Because the best of materials are put into the goods, the prices of standard supplies must necessarily be higher than those of inferior articles. Nevertheless, good economy in a power plant will always result from purchasing the best that can be secured. A. J. DIXON.

St. Louis, Mo.

From Among Readers' Problems

Conducted by
L. H. MORRISON

BLEEDING FROM RECEIVER FOR LOW PROCESS DEMANDS—*We have a compound four-valve engine of 400 kw. capacity exhausting at 5 lb. back pressure into our process lines. The steam consumption at full load is 12,000 lb. per hour, which is absorbed by the processes for about 60 per cent of the time; for the rest of the time we use about 2,000 lb. per hour in the processes, the remainder being wasted through a relief valve.*

Would it be feasible to attach a condenser to the low-pressure exhaust line and a bleed line to the receiver, so that at times of low process demands we could bleed the 2,000 lb. from the receiver and operate condensing. Q.V.

While mechanically the arrangement is possible, it is questionable if it would pay. In the first place, operating condensing the low-pressure compression would not reach as high a pressure at the end of the stroke, so that the crank would probably pound badly until the valve setting was altered, which would require stopping the engine when a change to condensing operation was made.

The reduction of steam consumption by condensing operation would be around 25 per cent, or $\frac{1}{4}$ (400 × 30) = 3,000 lb. per hour, if all the steam reached the low-pressure cylinder, but the draw-off of 2,000 lb. at the receiver would entail an addition of probably 1,000 lb. more to compensate for this loss. The total saving might reach 1,000 lb. per hour, which at 28c. per 1,000 lb. would amount to a substantial amount in a year. The necessary changeover valves, etc., would be expensive, and due to the varying load the savings would not reach those calculated.

STORING COIL FOR ELECTRICAL MACHINES—*Armature and field coils that we have had in storage for some time have shown poor insulation qualities when they were put into a winding. It is almost necessary to keep these coils in storage for ready use. How can this be done without having the insulation absorb moisture, or otherwise deteriorate?* W.M.B.

One of the best ways of storing coils is in an air-tight container. This method is not generally practicable. Another good method is to assemble the coils into as compact a group as possible and then wrap them with a heavy wax or oil paper to keep them from direct contact with the atmosphere. The package is packed in excelsior in a strong wooden box, and the cover nailed down and the box labeled to indicate what it contains. The packing material should be at least three inches thick around the coils. When coils are received from the manufacturer they should be left in their original packing until they are to be used.

Coils should not be stored where it is hot and dry, such as over a boiler, or where it is cold and wet. In the former instance the insulation is likely to dry out and crack, and in the latter it will absorb moisture. The temperature and humidity should be about the average that exists in most store rooms around industrial plants.

Where coils have been in storage for two or three years without being used, it is advisable to inspect them, and if their insulation shows signs of deteriorating they should be heated to drive out any moisture and then given a good coat of insulating varnish. The varnish may be applied by dipping the coils while hot; then let the excess drip off before drying. Or it may be brushed or sprayed on. In any case, care should be taken to thoroughly cover the surface with the varnish, so as to seal the insulation against the entrance of moisture. When the coils are dry they should be stored as previously described.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

SOME raw-water ice plants use high-pressure air for agitation in the cans; some low-pressure air. Under what conditions has one the advantage over the other? Is there any difference in the freezing time of ice whether high- or low-pressure air is used for agitation? If there is a difference—Why?

J.W.D.

IT WILL simplify discussion if the matter of comparative freezing time is settled first. By actual test it has been determined that low-pressure agitation normally retards freezing, thus causing a longer freezing time for this type of plant.

It will be readily seen that since the high-pressure air enters the can at a temperature below the freezing point it will perform a certain amount of refrigeration and thus hasten freezing, if only a little. Conversely, low-pressure air, which normally enters the can at a temperature above the freezing point, will give up some heat at the center of the ice block and thus retard freezing. The amount of heat introduced with the low-pressure air will depend upon the volume of air used, its temperature and humidity; but however great or little the actual quantity of heat may be, it will retard freezing to an extent far greater than its mere quantity would seem to warrant. This is because the heat is liberated at the center of the block and must travel through the surrounding shell of ice before being absorbed by the brine. The average thickness of this ice shell is from $3\frac{1}{2}$ to 4 in. for the entire freezing time, and as ice is a good heat insulator the removal of several hundred extra heat units from the center of the ice block might require a few more hours of time. Neglecting the exact calculations that might apply to any special set of conditions, it may be said that the freezing time will usually be from 2 to 7 per cent longer for low-pressure than for high-pressure systems.

Since the low-pressure requires a longer freezing time than the high-pressure system, it will naturally call for a little greater investment in cans and tank area. On the other hand, the high-pressure system will require a greater investment in air compressors and air-conditioning equipment.

As to power consumption, proponents of each system have claimed advantages for it in this respect. An impartial consideration of all factors involved would indicate, however, that the extra power consumed by the high-pressure air compressors is in many cases fully offset by the extra ammonia compressor power used in the low-pressure plants, due to the necessity of refrigerating a larger tank area and a much greater volume of agitating air. So there is no great power advantage for either system, although the low-pressure system may have some advantage in this respect

where conditions are particularly favorable.

Where the mineral content of the water is high, trouble may be experienced with the low-pressure agitation because of the formation of ice in the drop tubes long before the ice block is completely frozen. Besides spoiling of ice, this will increase power requirements through the necessity of pulling larger cores; also the freezing time will be increased. The use of high-pressure agitation under these conditions would not only eliminate these difficulties but would result in a better product.

On the other hand, where a plant operates on purchased electric power the low-pressure system has the advantage of being able to suffer a power interruption of a few hours' duration without losing agitation; whereas the loss of power for the air compressors in a high-pressure plant, even for only a few minutes, will result in the loss of agitation on the entire tank. The resulting white ice may represent much loss where there is no opportunity to market it.

The advantages and disadvantages of each system would appear to be as follows:

	Low-Pressure	High-Pressure
First cost	Slightly less	.....
Power consumption	Slightly less (usually)	.....
Quality of ice	.....	Usually better
Labor required	.....	Less, especially in large plants
Operating troubles	.....	Fewer, as a rule
Trouble due to power interruptions	Less	.....

The items of first cost and power consumption will usually be in favor of the low-pressure system. But this assumption will not hold for all conditions, particularly where the mineral content of the water is very high. The high-pressure plant will require less labor per ton of ice produced, but this will be no particular advantage in a small plant, where only one man per shift will be employed anyway. The quality of ice produced from bad water will be much better with high-pressure agitation, but where the water is comparatively free from mineral either system will produce good ice.

It will be seen that the intelligent choice of a plant depends upon the careful consideration of all factors relating to the installation in question.

M. F. KNOY.

Beaumont, Texas.

CHOICE of low- or high-pressure agitation for a raw-water ice plant depends on two things: The size of the plant, and the amount of mineral matter contained in the water used in freezing the ice. In the low-pressure system, where 2 to 5 lb. air pressure is used, much labor is expended in changing the air tubes in the cans; and if the water has a large amount of minerals it will be difficult to make a first grade of ice.

The high-pressure system, with 15 to 30 lb. of air pressure, naturally has a higher installation cost; but I have found it will pay for itself in the smaller amount of labor required to change air tubes, for the air tubes are fastened permanently to the cans. Even if the water contains an excessive amount of mineral matter, a superior grade of ice can be made.

We recently changed our agitating system from low-pressure to high-pressure because of the mineral condition of the water, and we have obtained splendid results in the clarity of the ice. There is no difference in the freezing time.

WILLIAM A. MEINECKE.

Elmhurst, Ill.

A Question for Our Readers

IN CONNECTION with a 3,000-kw. turbine we have a condenser with two horizontal banks of tubes without steam lanes. With cooling-water inlet temperature of 42 deg. F. and air leakage of 4 cu.ft. per minute the performance is as follows: When handling 8,000 lb. of steam per hour, absolute pressure 0.85 in. Hg., exhaust temperature 74 deg. F., condensate temperature 49 deg. F. and cooling water outlet 48 deg.; when handling 35,000 lb. steam per hour, absolute pressure 1.35 in. Hg., exhaust temperature 90 deg., condensate temperature 64 deg., and cooling-water outlet 62 degrees.

Would it be possible, by eliminating a portion of the tubes and forming steam lanes deep into the tube bank, to improve the performance of this condenser? If so, what would be the best arrangement and amount of steam lanes and what would be the most practical way to close the openings in the tube sheet? R.V.G.

Suitable answers from readers will be paid for[1] and published in the March 10 number

[1]Instead of cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.)

Morrison's *American Diesel Engines;* Walker and Crocker's *Piping Handbook;* Norris and Therkeisen's *Heat Power;* Emswiler's *Thermodynamics;* Church's *Steam Turbines;* Uehling's *Heat Loss Analysis;* Croft's *Steam Power Plant Auxiliaries and Accessories;* Powell's *Boiler Feed Water Purification;* Osborne's *Power Plant Lubrication;* Moyer and Fittz' *Refrigeration;* Rietschel-Brabbee's *Heating and Ventilation;* Annett's *Electric Elevators.*

I THINK there is no difference, if both systems are well designed. Assuming that the air tubes are submerged 36 in. in the cans, the static head against the air pressure is 21 oz., as it is usually expressed, and some plants operate with 24-oz. pressure in the mains, using large delivery pipes.

So far as I have been able to determine, a bubble of air every ten seconds is as good as a cubic foot, as anything that keeps the water in motion will produce clear ice. The same result is accomplished by high pressure and small tubes, but if the low-pressure system has ample size of pipe, so that the friction of the air is reduced to low limits, satisfactory ice can be made. At one plant that changed over to high pressure, the mains were so small that the air did not have sufficient pressure to escape through the water at the farther end of the tank, and nothing but snow balls came from the last three rows.

Two arguments advanced against high pressure are that the air is heated, thus lowering the capacity of the tank, and that the heat carries over some of the lubricating oil used in the air pump. Both of these sound well in theory but have no practical application.

As to the second question, assuming that the same amount of air is delivered to each can in either case, there would be no difference in freezing time, as air has slight capacity for heat as compared to water. Anyone who has operated a low-pressure plant in very cold weather has noticed that air taken from the outside will frequently freeze the tubes before the entire can is frozen. I think that close attention to the tubes and connections is of more consequence than a difference in air pressure; clear ice is made by either method.

Cleveland, Ohio. L. R. BAKER.

PROBABLY the first widely used system of agitation for raw-water can ice was the low-pressure drop-tube type. This system could be readily adapted to existing cans and freezing tank structures, since it consisted merely of a metal air tube suspended by a bracket in the middle of the can, the tube extending about three-fourths of the way to the bottom of the can and being connected to a source of air capable of maintaining a pressure of two to three pounds.

This system was open to the objection that the ice formed eventually closed the end of the air tube if the tube were not removed just previous to that occurrence. In either event the air agitation was discontinued at this point, with the result that opaque ice was formed after agitation ceased.

To get around this difficulty, the high-pressure system was developed, in which the air is supplied to the blower tube in the can under sufficient pressure to prevent blocking off of the tube by the ice formed. The blower tube is allowed to freeze in the block of ice, to be subsequently removed by a thawing needle. Since by this method air

agitation is maintained until the block of ice is completly frozen, practically the entire block is clear ice.

Advocates of the low-pressure systems then evolved a drop tube with small perforations along its length. This type of tube is allowed to freeze in the ice block and is later removed by means of a thawing needle. When the ice forms in the can and closes the bottom of the drop tube the air passes through the perforations in the side of the tube, thus continuing the agitation of the water until the block is completely frozen, producing practically clear ice throughout the block.

The important considerations in the making of clear ice are the quality of the raw water, the freezing temperature, the continuity of agitation, and the number of cubic feet of air per can per minute, rather than whether the air agitation system is high- or low-pressure.

With reference to the time required for freezing with the two systems, it is my opinion that the high-pressure-agitated water will freeze in somewhat less time than the low-pressure-agitated water, simply because the agitation air used in the high-pressure systems is chilled nearly to the freezing point to remove moisture from it before it is introduced into the distribution system. Hence, it carries less heat into the water being agitated than does the low-pressure system.

But since the high-pressure air is dehumidified by refrigeration, the total amount of heat to be absorbed per ton of ice produced will be substantially the same with either type of air-agitation system, providing the same number of cubic feet of free air is supplied per can per minute. The high-pressure system requires slightly more power per ton of ice produced.

A. C. EMBSHOFF.

Chicago, Ill.

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Tests Reveal Efficiency of Clarkson Waste-Heat Boiler

At a recent meeting of the metropolitan section of the A.S.M.E., Mr. Clarkson portrayed the development of the Clarkson boiler, presenting pictures of various installations on diesel engines and test results. The following was prepared from his address

By THOMAS CLARKSON

Westminster, England

THE CLARKSON BOILER was first developed to serve as a steam-producing unit in steam lorries. Operation in this service disclosed characteristics that made it appear suitable for use as a waste-heat boiler, particularly in connection with diesel engines.

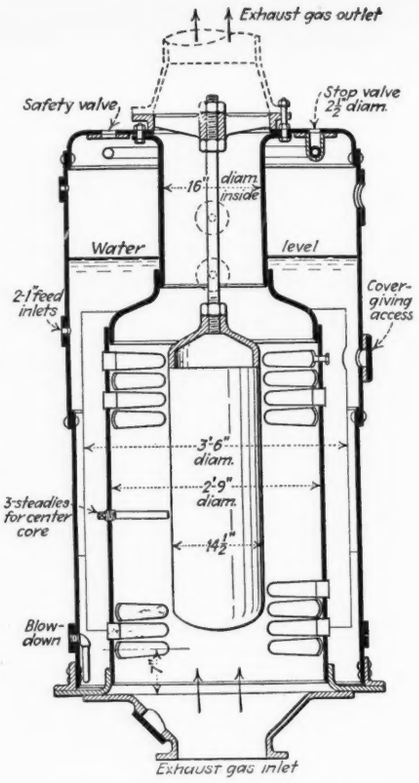
The diesel engine is capable of converting about 30 per cent of the heat in the fuel into mechanical energy. Most of the heat not utilized is lost in exhaust gas or to the engine jacket water. If the heat in the exhaust gas is used to further heat the jacket water for use in an industrial process, about 75 per cent of the heat in the fuel is recoverable. If, however, the exhaust gas is used to generate steam not all of the jacket water can be used as feed to the boiler and the recoverable heat drops to 50 or 60 per cent.

To be suitable as a waste-heat boiler using diesel engine exhaust the unit should be simple, reliable and capable of operating dry without injury.

In the Clarkson boiler water is contained in the annular space formed by the outer and inner shells. Into the inner shell are rolled short thimble tubes that are larger in diameter at the open end than at the closed end. Thus the boiler has much the appearance of an inverted porcupine boiler.

The hot gas, as shown in the illustration, passes up through the tubes and out at the top, the center core or baffle forcing the gas to scrub the tubes. Several other baffle arrangements are used, depending upon installation conditions. For example, the center core may be arranged so that the gas entering at the top passes down through the center and up around the tubes, discharging at the top. The tubes are placed closer together as the end of the gas travel is approached, in order to maintain its velocity as gas volume decreases. The unit acts as a muffler and does not appreciably increase the back pressure on the engine.

The ratio of the length to the diameter of the thimble-shaped tubes is important for proper operation. When this ratio is correct, observation indicates that during the heating period water enters the bottom of each tube and after being heated leaves at the top. When steam forms, this simple circulation stops and a pulsating action is set up. Tests made for determining to what extent the tubes may be forced show that evaporation rates as high as 45 lb. per square foot of pipe surface are possible without indication of tube overheating. Steam is removed through a perforated-ring dry pipe.



Cross-section of Clarkson waste-heat boiler

A baffle plate in the annular water space extends from above the top row of tubes down to next to the bottom row. Feed water is introduced in the side just below the top of the baffle plate and flows down along the outer shell and up along the tube inlets.

Operation of the boiler indicates that even with poor water little trouble from scale need be expected. Boilers have operated for two years without requiring cleaning.

Tests show efficiencies of 86 per cent based on heat in exhaust, excluding latent heat of the water vapor in the gas. About 0.8 lb. of steam per horsepower is generated when used with four-stroke-cycle engines and 0.4 lb. when used with two-stroke-cycle diesels.

Operation of the diesel engine without water in the boiler has caused no trouble. It has withstood the severe test of turning in cold water while the boiler was at a temperature of 1,050 deg. The largest unit so far built is of 16,000 to 20,000 lb. of steam hour capacity. Units have been arranged for auxiliary firing with oil or pulverized coal.

Discussion brought out that the boiler could operate with sea water, providing that, by frequent blowing down, the density of the water in the boiler was maintained at not over twice the density of sea water. Corrosion difficulties are not encountered if the temperature of the exit gas is kept above the dew point.

Civil Engineers Present Diversified Power Program

THE 78TH annual meeting of the American Society of Civil Engineers was held in the Engineering Societies Building, New York City, Jan. 21 to 23. On Thursday afternoon the Power Division held its session, at which three papers were presented, dealing with burning natural gas under boilers, erosion at spillway dams and a description of the addition to the Spier Falls plant of the New York Power & Light Corporation.

Natural Gas as a Boiler Fuel

"Natural Gas for Steam Boilers" was the subject of a paper by G. I. Rhodes, vice-president of Ford, Bacon & Davis. Natural gas was characterized as the ideal fuel for steam boilers. It is smokeless and it is possible to operate at high capacity with low draft losses and low maintenance costs. A number of outstanding plants burning natural gas are located in Louisiana and California and there are some plants in the West and Middle West.

An analysis was given of several types of boiler plants burning natural gas, fuel oil and Alabama coal. The plants are:

A—Modern large boilers equipped with water walls, economizer and air preheaters, in which stack-gas temperatures as low as 300 deg. F. are frequently obtained and in which the temperature differential due to excess air is probably one-half that experienced in the ordinary plant. Such furnaces are commonly used for pulverized coal, oil or natural gas, practically unchanged for the different fuels.

B—Modern large boilers equipped with water walls but without economizers or air preheaters. In these settings normal flue-gas temperatures are to be expected and low amounts of excess air are possible with all fuels.

C—Large boilers with firebrick-lined furnaces such as are commonly used for stoker and for oil firing and sometimes for pulverized-coal firing in converted plants. In these plants it is necessary to use considerable excess air to keep the furnace temperatures within a safe operating range.

D—Boilers of ordinary size with furnaces as in C.

E—Hand-fired boilers with good operation.

F—Small hand-fired furnaces with ordinary operation.

The table gives the boiler efficiencies to be expected with natural gas and other typical fuels under normal operating conditions in the plants previously outlined. The analysis of the plants includes all factors affecting operation, such as the fuels' composition, heat value, hydrogen loss, ash losses, cost of fuel, cost of handling fuel, cost of burning, factors affecting heat losses, maintenance costs, boiler and furnace efficiencies, etc.

The opinion was expressed that there can be no rule-of-thumb method for evaluating natural gas. It differs in different types and sizes of plants as well as with the kind and delivered cost of other fuels. It is believed that natural gas can economically come into much greater use as a power station fuel when there is a full appreciation of all of the facts and factors surrounding its supply and use. With the full development of the economic possibilities of power station fuel, unrestricted by other considerations, some pipe line companies could materially increase their earning capacity, boiler plant owners could reduce their costs and the community would benefit through a reduction in the smoke nuisance.

SUMMARY OF EXPECTED OPERATING EFFICIENCIES WITH BOILERS BURNING TYPICAL FUELS

Boiler Types	Natural Gas—Monroe 21,000 B.t.u. per Lb. High	Natural Gas—Monroe 21,000 B.t.u. per Lb. Low	Fuel Oil 18,000 B.t.u. per Lb. High	Fuel Oil 18,000 B.t.u. per Lb. Low
A	85.0	83.5	88.2	86.7
B	78.9	76.9	82.2	80.1
C	76.9	73.9	77.0	73.3
D	75.9	72.9	74.3	70.6
E	75.6	72.1	72.7	69.0
F	74.6	70.1	71.7	67.0

Boiler Types	Alabama Coal, 13,200 B.t.u. per Lb.—Pulverized High	Pulverized Low	Stoker- or Hand-Fired High	Stoker- or Hand-Fired Low
A	88.2	85.8	83.9	79.0
B	81.2	78.1	75.7	69.6
C	76.2	71.0	71.9	65.7
D	73.5	67.4	69.0	60.4
E	....	....	61.3	50.9
F	....	....	54.9	42.5

Spier Falls Addition Described

Supplemented by lantern slides, John P. Hogan, consulting engineer, New York City, presented a paper on the "Addition to the Spier Falls Plant of the New York Power & Light Corporation." The original plant was laid out for ten 5,000-hp. horizontal shaft units. Seven of these units were installed, and later a 9,000-hp. vertical unit was added. The latest addition is a 57,000-hp. vertical-shaft machine to operate under an 81-ft. head at 81.8 r.p.m. Space has been provided for a second unit of the same size. This is the largest Francis-type runner in operation, in point of discharge capacity. At full load the runner will discharge 7,000 sec.-ft. Minimum regulated flow of the Hudson River is 3,000 sec.-ft., and 5,000 sec.-ft. for 50 per cent of the time. When Spier Falls is completely developed it will have capacity to discharge 20,000 sec.-ft., or an installed horsepower of about 160,000.

Two main factors contributed to the large increase being made in the Spier Falls plant's capacity. First, the regulation of the Hudson River by a large storage reservoir at Conklinville, and, second, the plant is being developed to supply peak-load capacity. When the upper Hudson is completely developed there will be twelve plants having a total capacity of about 1,000,000 horsepower.

Models Save $100,000 in Construction Costs

Extensive investigations were made of the design of the addition to the plant on models at the Hydraulic Laboratory of the Worcester Polytechnic Institute, Worcester, Mass. These model tests cost about $10,000 and resulted in a saving of $100,000 in construction, in addition to the satisfaction of knowing that the design was the best to be had for the conditions.

The generator for the unit is rated at 47,000 kva. and is the largest in dimensions that has been constructed. It has an outside diameter of 43 ft. The total weight of the rotating element is about 450 tons and is carried on a thrust bearing below the rotor. Placing the thrust bearing below the rotor resulted in a saving of about $40,000 compared to the cost of a plant with the thrust bearing above the generator. The generator has a closed system of ventilation and is connected directly to the step-up transformers with an intervening bus.

It was Mr. Hogan's opinion that this unit represented about the limit in dimensions that it would be economical to build. The water passages become so large that they offer serious structural problems. The penstock and scroll-case entrance to this unit are 26 ft. in diameter, and the draft tube and discharge passages are proportionally large. Also, there is very little saving in cost in using larger units. When considering the units for this plant it was found that two 57,000-hp. machines cost very little less than three of 38,000-hp. rating.

Even though the new unit had to be installed on the site of an extension to an old plant and the latter had to be kept in operation, all of which was a handicap, the new project was put in operation one year after starting work. The work included completing the headworks and part of the draft tube for a second 57,000-hp. machine.

In the discussion on this paper it was brought out that the taintor gates on top of the dam are kept free of ice by a system that discharges compressed air under the surface of the water on the upstream face of the gates. This system has kept the gates free of ice in temperatures of 20 deg. F. below zero.

Correlated Erosion Data Needed

Robert F. Ewald, hydraulic engineer, Aluminum Company of America, in a paper "Experience With Erosion at Spillway Dams," discussed the importance of water cushions at the discharge end of spillways carrying water at high velocities, special reference being made to the part played by the hydraulic jump in decreasing undesirable erosive action. Inasmuch as a few modern dams have failed as a more or less direct result of erosion at the toe, and other dams a

few years old require, or are believed to require, the installation of means to correct the effect of erosion at considerable cost, it was the author's opinion that a widespread and thorough presentation of information by engineers is necessary to obtain a complete understanding of all phases of this subject. It is time that the correct principles were firmly established by general agreement of the best engineering minds, he thinks.

Data Based on Erosion Surveys

Data were submitted based on surveys of erosion at the toes of three gravity-ogee spillway dams on the Yadkin River and one on the Little Tennessee River in North Carolina. These dams do not include special structures built to develop the jump, but they have been carefully studied as to possible damage by erosion and the expectation of the ultimate formation of the jump in eroded pools formed without affecting the stability of the dam.

On what is known as the Narrows dam on the Yadkin River the water level is raised 181 ft. Water velocity at the toe of the dam before entering the channel is slightly over 100 ft. per second. Four large floods have been taken over this dam. In 1917 a 40,000-sec.-ft. flood eroded rock from below the toe of the dam to a depth of from 5 to 6 ft. Since that time floods up to 55,000 sec.-ft. have been passed over the dam and 70,000 sec.-ft. through a bypass spillway without any further serious erosion at the dam's toe.

In the flood of 1929, which was one of the largest passed by the dam, material was deposited along the toe of the dam where erosion had occurred in the earlier floods. As the bottom is eroded to the requisite depth, no further erosion is expected and stable conditions have been established.

The Cheoah Dam on the Little Tennessee River raises the water 195 ft. and the velocity at the toe is 105 ft. per second. The erosion at this dam has been relatively small, averaging not over 5 ft., and apparently all took place in 1920 when a flood of 70,000 sec.-ft. passed over the dam. As the margin between available depth and required depth at this dam, with flow distributed to best advantage, is less than 10 ft. at all stages, no further erosion is expected.

Ogee Type Dam Preferred

At the Narrows Dam in 1929 and at Cheoah Dam since 1920 loose material was piled against the toe of the dam at those times when sufficient depth was available to develop the jump without the aid of channel friction. This appears, according to Mr. Ewald, to lead to the conclusion that at the toe of ogee spillway dams, when sufficient depth of water is available to permit the jump to develop without the aid of channel friction, dangerous erosion directed at the dam's toe is completely absent, vindicating the preference of many engineers for the ogee type as compared to the straight drop.

The discussion on this paper brought out that no effort had been made to prevent erosion at the toes of the dams described in the paper other than providing a pool. So far the amount of erosion is about what was expected under the conditions. This has now apparently reached a stable state. After each flood a survey of the bottom of the pool below the dam is made. If, in the future, serious erosion develops, which is not expected, some means of preventing it will have to be provided. All of the dams described in the paper are built on very hard rock.

The necessity of model tests on overflow dams was emphasized to determine the action of the water at their toes and any other effects. Where a dam is to be built on hard rock it was considered difficult to find out what the effect of the water would be. It was suggested that in making model tests the worst possible conditions should be assumed and model tests made on that basis.

Lack of symmetry in flow was suggested as one of the most serious causes of erosion. A case was cited where, below a dam built on loose material, serious erosion developed where the water flowed in eddies. Correcting the cause of the eddies stopped the erosion.

Attention was called to several dams that have given a great deal of trouble due to erosion and on which aprons had been rebuilt several times. Each time aprons of a different design were used, but with the next flood they were carried away. It was proposed that effort be made to have data collected on experiences with erosion at the toes of overflow dams, to be made part of the discussion on Mr. Ewald's paper.

L. F. Harza presented the interim report of the committee on state legislation on dams. The report was presented as a basis of discussion, preliminary to preparing the final report to be presented one year hence or later. The failure of the St. Francis dam in California emphasized the necessity of legislation to regulate the design, construction and maintenance of such structures. Since state regulation is inevitable and desirable, this committee was formed to assist in drafting laws that would insure safe dams and at the same time not interfere with progress of the art. A discussion on the report by A. H. Markwart pointed out the favorable results obtained by the recent regulation adopted in California.

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WORDS, FACTS and TRUTH*

WORDS are interesting things, even to engineers. The best word is the one that labels one idea and only one; the poorest word for real use is one that tags so many ideas as to lead to nothing but uncertainty.

Recently a popular philosopher has somewhat dogmatically asserted that science "begins with uncertainty and ends with a fact." I believe he correctly interprets both the purpose and the procedure of scientific investigation. I always feel that I am on safe ground when I speak of facts to an engineering audience. First of all I do not need to demonstrate to you the inherent value of facts—their essential importance, their everyday usefulness.

Definition of a Pessimist

Fact-finding is the engineer's first task; fact-facing is his first duty. The truth can make us free only as we face the facts. The best definition I know of a pessimist is one who has done business with an optimist, and I would add that too often the optimist is one who hasn't faced the facts. The engineer must face the facts as he plans for the future, and I dare suggest that planning for the future is pre-eminently the function of the engineer.

I realize that fact-facing isn't always popular. Negative conclusions following any investigation rarely meet with an enthusiastic reception. Indeed, fact-finding is sometimes discouraged in the fear that the facts will oppose the project. But the facts must be faced: words expressive of facts must not be soft-pedaled, nor should facts be wrapped in the cotton wool of meaningless phrases.

The engineer, then, not only finds his facts and faces his facts but follows his facts. "Man afraid of his facts" is no sort of a name for an engineer. Rather he is afraid of too few facts, and it is because of this fear that he introduces a factor of safety into his calculations—something unknown or at least unused by the investigator of the unscientific type.

Why and How

The engineer's attitude toward the truth is obvious: He is the accredited advocate for the truth. The mastery over the forces of Nature that has been given to man by engineering has been won not so much by occasional flashes of spectacular genius as by the long-continued piling up of facts. Science, with its urge to know *why*, and engineering, with its urge to know *how*, have together contributed in generous measure to human progress. And this spread of scientific research and of engineering practice has been nothing more and nothing less than the spread of the truth. It is the truth that makes us free—there is no other route, and thanks to his type of training, to his mode of thought, and above all to his professional ideals, it is the engineer who surveys that pathway. To him words are of only passing interest; to him facts are guiding landmarks; to him the truth is the goal.

*Excerpts from a talk delivered by George Otis Smith on Jan. 16 at a dinner of the American Engineering Council.

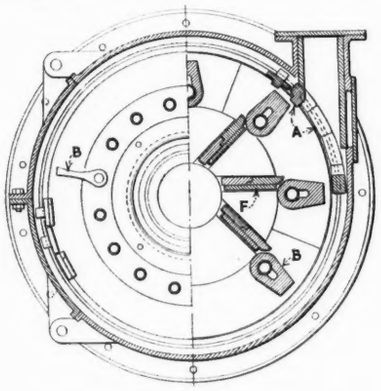
WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Vertical Multi-Stage Pulverizer

IN THE accompanying illustrations are shown cross-sections of a vertical multi-stage coal pulverizer, designated uni-flo, recently developed by the Heat Utilities Corporation, 5 Beekman Street, New York City.

The mill consists of a circular steel casing heavily lined with easily replaceable sectional liners *A* made of alloy steel, inside of which the breakers *B*, arranged in three stages, revolve.

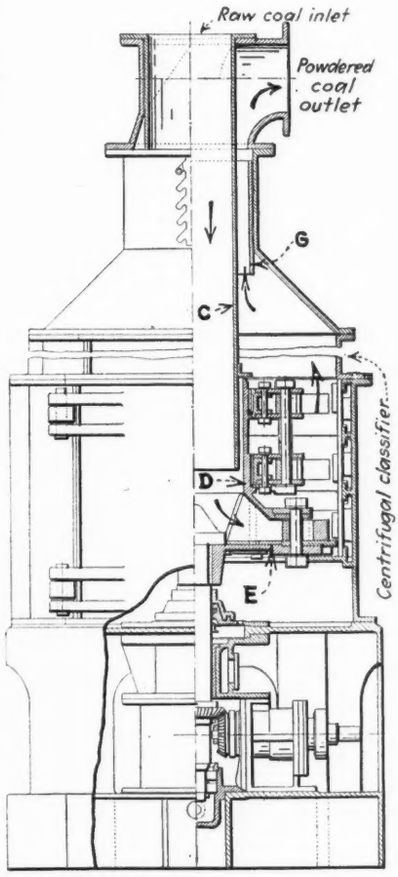


Horizontal cross-section of pulverizer

The coal reaches the mill from a table-type feeder and enters, mixed with air, at the top of the mill into a stationary feed pipe *C* placed in the center, and discharges from this into a rotary delivery tube or distributor *D*, which not only leads the material and air to the hammers, but also carries the hammer disk of all the stages.

At the bottom of the delivery tube a rotary table *E* is connected to the tube by radially placed ribs *F*, leaving ample opening for material to travel radially outward to the hammers. The delivery tube, ribs and table are a solid steel casting carried by a heavy vertical shaft having its bearing below the table and driven through a spiral bevel gear. Both ribs and table are lined with easily renewable plates.

The coal, which enters the mill downwardly, completes a "U" flow, as indicated by the arrows, and after passing from the rotary delivery tube to the liner advances in a spiral movement upward. During this motion centrifugal force and gravity act to separate the heavier particles and return them to the lower stage for further grinding. Separation is also assisted by slanting ribs on the renewable liners opposite the hammers.



Partial vertical cross-section showing constructional features

To accentuate the selective separation, air spaces of considerable height are provided between the stages, in which the air and material can circulate freely. Final separation of particles takes place in the classifier placed above the hammer stages. The adjustable tube *G* regulates the fineness according to its relative position to the classifier casing. A large throw-out pocket for foreign material is incorporated in the casing.

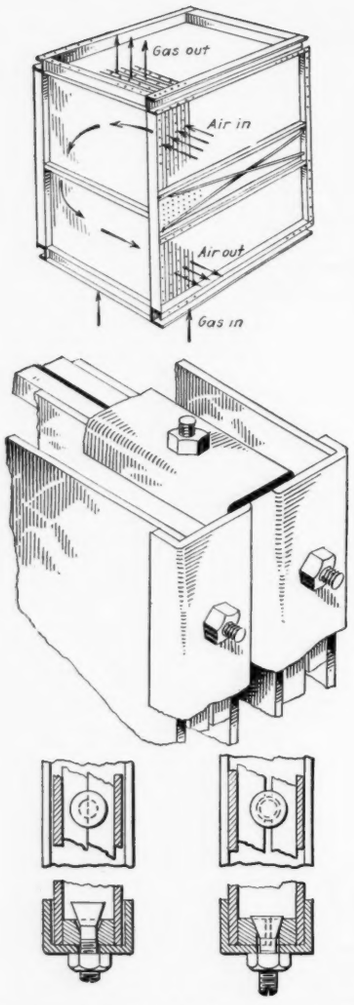
Accessibility for the replacement of wearing parts is an important feature of this pulverizer. It is possible to replace the entire set of hammers or casing liners through two hinged doors on the side of the casing. These doors are flanged and are bolted where they come together, as well as at the top and bottom.

An independent variable-speed fan is provided with the mill, the use of which facilitates adjustment of the burner, as variable volume and pressure can be obtained.

Channel-Type Air Heater Without Welded Joints

THE Thermix (Type C) channel-design air heater, recently introduced by the Prat-Daniel Corporation, 183 Madison Avenue, New York City, is in its main features similar to the Thermix air heater Type A manufactured for a number of years by that company and also by Babcock & Wilcox Company, New York City, for boiler preheat. The important feature of Type A, that of utilizing plates directly from the mill without welded joints in the gas and air elements, has been retained in the Type C, the latter having been developed primarily for gas temperatures above 1,000 deg. F., where it is an advantage to have no spacers whatever in the hot gas.

Referring to the illustration, there is shown a general assembly, details of a corner with packing removed and the method of obtaining the vise or clamp along the edges of the plates. This vise is composed of a channel (of nickel-chrome steel where desirable in the case of high temperature) against the inside of the flanges of which rest the edges of the heater plates. These plates are forced tightly against the channel flanges by two parallel bars which in turn are forced apart by the shoulders of special bolts at 4-in. intervals. These bolts fit in countersunk openings between the



Heater assembly, detail of corner with packing removed and method of clamping the edges of the plates

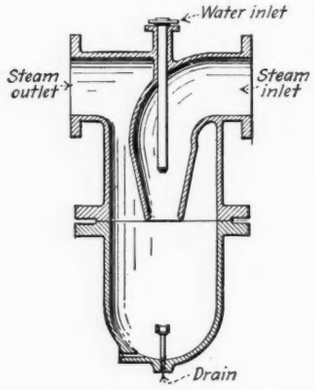
bars and are tightened by nuts on the outside of the channels.

It is claimed by the manufacturer that this construction gives a uniformly tight joint even at high-temperature differentials on the inside and outside of the channels. On actual tests a pull of 500 lb. per lineal foot was insufficient to dislodge the channel when its exterior was maintained at 1,200 deg. F. and its interior cooled by compressed air to obtain the maximum expansion conditions (approximately 0.004 in. divided between four surfaces).

Desuperheater With Thermo-Hydraulic Governor

EMPLOYING the principle of atomization as used in the automobile carburetor, the new desuperheater put out by the Swartwout Company, 18511 Euclid Ave., Cleveland, Ohio, is available in standard pipe sizes from 3 to 24 in. inclusive and for three standard pressures, 250, 400 and 600 pounds.

Steam enters a throat tube in the center of the desuperheater, where it is met by a conical stream of cooling water introduced through a central pipe. Superheated steam flowing through the throat at high velocity vaporizes and evaporates the cooling water, giving up a certain amount of heat in the process, resulting in a



Section of carburetor-type desuperheater

reduction in the final temperature of the steam.

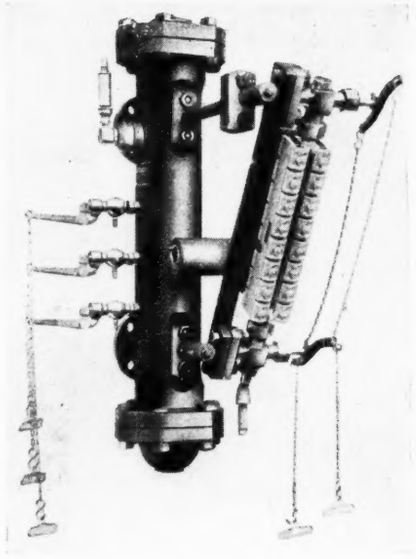
The temperature of the steam leaving the desuperheater is controlled automatically by a desuperheater governor inserted in the water line, with the generator for the governor located in the discharge steam line at a convenient point adjacent to the desuperheater. The generator of the governor, which operates on the thermo-hydraulic principle, may be installed in a vertical or horizontal pipe, elbow or tee, or with welding necks, as best suits installation requirements.

To meet conditions where the pressure must be reduced as well as the temperature a complete reducing and desuperheating station is available.

High-Pressure Water Gage

IN THE NEW WATER GAGE for high pressures, designated "Micasight," now being put out by the Reliance Gauge Column Company, Cleveland, Ohio, glass is eliminated entirely, mica only being used. The gage is designed for working pressures up to 2,000 lb., but according to the manufacturer the mica is supported so that it will withstand a pressure of 3,000 pounds.

The body is made from steel with a slot in the center to form the water

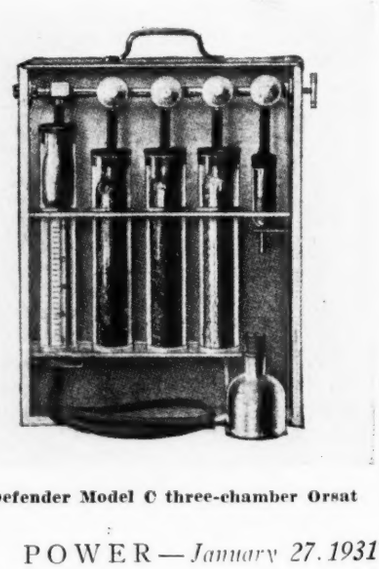


Reliance "Micasight" water gage

and steam space. The slot is closed on each side by a thin sheet of mica held in position by a bronze cover plate having a $\frac{1}{8}$-in. slot in the center. The cover is secured in position by a series of short clamps and studs as shown. A special illuminator attached at the back of the glass permits the water level to be seen distinctly from a considerable distance. Vertical and tilt-view types are available.

Improved Flue Gas Analysis Instrument

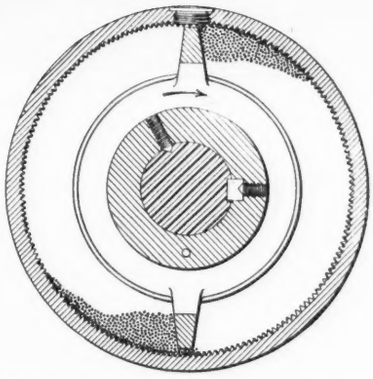
THE USE of a rustless one-piece steel header with steel needle-point valves completely enclosed within the case characterizes the Model C gas-analysis instrument put out by Defender Automatic Regulator Company, St. Louis, Mo. In



Defender Model C three-chamber Orsat

this model, which is available in one-chamber and three-chamber types, the front and rear covers are slid into place from the top instead of being hinged as is the usual practice.

The header is held in place by two fittings, one at each side of the case and a screw is fitted in the header at each end so that the header can be cleaned readily while in position. A leather carrying case for the instrument can be furnished when desired.



Schematic diagram showing how shot builds up in front of wings

Improved Centrifugal Clutch

IN THE Feb. 4, 1930, number of *Power* the Pulvis clutch as put out by A. B. Pulvis, Stockholm, Sweden, was illustrated and described. Since that description appeared the American sales and manufacturing rights to this clutch have been acquired by the Hill Clutch Machine & Foundry Company, Cleveland, Ohio, and an improved design of the clutch is now being offered by this manufacturer.

Briefly, the clutch, designed to give slow acceleration and prevent overload, consists of three parts, a cylindrical housing attached to the driven unit; a winged hub free to revolve within the housing and constituting the driving member; and a quantity of chilled balls or shot which form the power-transmitting medium between the two members. The balls are only 0.023 in. in diameter and are graphite-coated for atmospheric protection and for lubrication.

Pulley-type clutch

In operation, the chilled shot forms in drifts ahead of the wings, as shown by the schematic illustration, and by centrifugal force the density of the shot drift is increased to a point where the friction on the inner serrated surface of the housing is sufficient to hold the two members stationary in relation to one another. If the load increases above normal the machine slows down, while the motor continues to run at approximately normal speed. When the load returns to normal the machine is again accelerated to the speed of the motor.

Some of the important improvements made to the clutch since it was first introduced are the use of steel wings and hub, highly refined shot, improved method of sealing at each end of the hub, and the use of a telltale device that indicates duration of starting time and shows overloading.

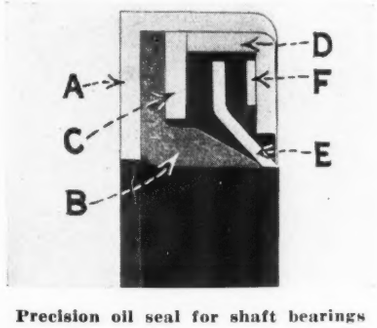
Practically any accelerating characteristic and driving power can be obtained by changing the quantity of chilled shot.

In addition to the pulley type shown, the clutch is made in a coupling type for direct drives and an extended sleeve type for other than belts or direct drives.

Shaft Bearing Oil Seal

DESIGNED to exclude dirt, grit, water and foreign matter from bearings, the precision oil seal put out by Gits Brothers Manufacturing Company, 1846 South Kilborn Ave., Chicago, Ill., operates equally well on horizontal and vertical shaft applications.

Referring to the illustration, the seal is made up of six parts, an outer retaining member A, a leather gasket B, gasket washer C, an inner retaining member D, a gasket expanding member E, and a crimped annular spring F for sealing the feather edge gasket against the shaft. The gasket is beveled to a feather edge and the ring F is made to bear against it just back of the edge so that it is held firmly but without excessive pressure against the shaft.

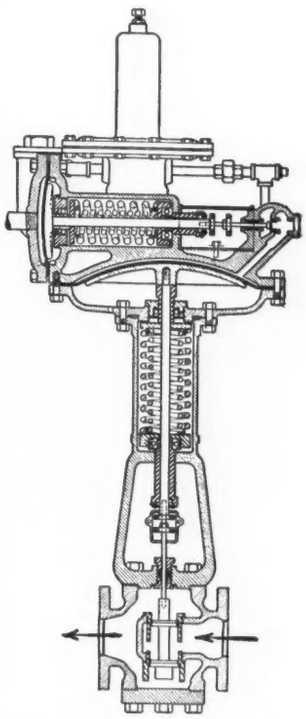


Precision oil seal for shaft bearings

The seals are available in shaft sizes from $\frac{7}{16}$ to 6 in. inclusive, the outer diameter being 1.127 in. and 7.506 in. and the width from $\frac{13}{32}$ to $\frac{3}{4}$ for these limits.

Steam Regulator With Air-Operated Pilot Valve

IN THE steam-pressure regulator No. 200 built by the Neilan Company, 641 Santa Fe Ave., Los Angeles, Calif., the pilot valve is operated by an external supply of air pressure rather than by the live steam pressure as is the usual practice. Because of this feature, according to the manufacturer, the regulator gives a constant steam pressure within exceptionally close limits regardless of variation of the inlet steam pressure.



Section of Model 200 regulator

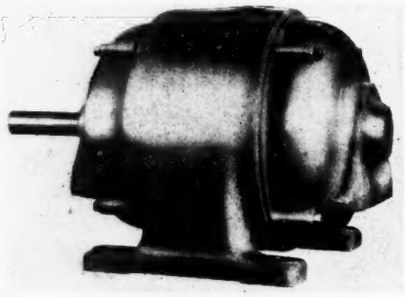
This regulator is essentially a combination of three separate regulators —an auxiliary reducing valve, a pilot

valve and a main valve. The pilot valve is normally held open by compression springs. Operating air from an auxiliary reducing valve flows through the pilot valve to the main-valve diaphragm. This pressure overcomes the force of multiple springs holding the main valve closed, and the valve opens, permitting high-pressure steam to flow through the valve. A connection is made from the reduced-pressure side of the main valve to the pilot valve diaphragm. Hence when the reduced pressure reaches the desired point the pilot valve closes and shuts off the operating air to the main-valve diaphragm.

Both the pilot and main diaphragm plungers and valve stems float freely in ball bearings, and the adjusting screws also work against ball bearings. Stainless steel parts are used. The regulator may be operated on any air pressure between 15 and 150 lb. Sizes available range from ½ to 16 in., suitable for pressures up to 600 pounds.

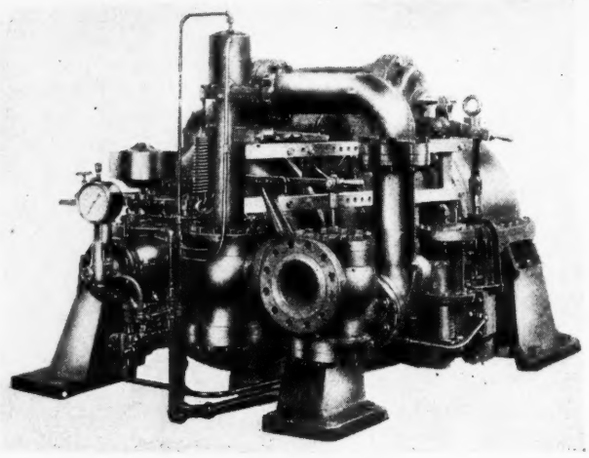
Motors With Herringbone Rotors

MOTORS from 1 to 50 hp. are now built by Sterling Electric Motors, Inc., Telegraph Road at Atlantic Blvd., Los Angeles, Calif., with herringbone rotors to achieve quiet operation. These motors are suitable for such applications as ventilating fans, direct-connected pumps, or other application where quiet performance is important.



Sterling motor using a herringbone type rotor

Among the features of these motors brought about by the herringbone rotor, according to the manufacturer, are: noiseless operation; no end thrust and resulting wear on bearings; improved pull-out efficiency and power factor; and reduced starting current, heating, eddy currents, and iron losses. Mica and asbestos are used to insulate the motor windings.



Multi-stage steam turbine with wide range of power and speed

Steam Turbine Designed for Wide Range of Operating Conditions

THE wide range of operating conditions for which steam turbines are now being adapted is illustrated by the multi-stage unit developed by the Moore Steam Turbine Corporation, Wellsville, N. Y., for driving gas boosters. This unit, especially designed to cover a broad range of power and speed and to meet certain heat-balance conditions, is equipped with five governing controls, and, in addition, three safety devices.

The unit is designed to develop, normally, 500 to 750 hp. at 3,600 to 3,750 r.p.m., the speed being controlled from the outlet pressure of the gas booster, to which it is directly connected. In emergency the unit can be speeded up to 4,500 r.p.m. to develop 1,480 hp. An automatic governor-operated overload valve admits steam to an extra group of nozzles when this maximum power is required. The steam conditions for which the turbine is designed are, inlet pressure, 350 lb.; superheat, 100 deg.; and bleeder pressures, 125 and 10 pounds.

By means of an automatic control steam is delivered from or taken into the 10-lb. connection, the admission of steam at this bleeder point being also under control of the speed governor, but only after the high-pressure steam has been shut off.

Although the machine is designed to operate normally condensing at 28 in. vacuum, extra capacity given by the automatic overload valve permits the unit to carry normal load non-condensing when necessary.

Improved Car-Pulling Unit

REGULARLY built in three sizes to handle from one to six 80-ton cars, this improved electrically operated capstan car puller is self-contained, weatherproof and designed to pull cars, trucks, etc., at any angle. The motor and gear-reduction drive for the winding drum are assembled as a unit on a heavy over-all bedplate. The puller is put out by the Webster & Weller Manufacturing Companies, 1856 North Kostner Ave., Chicago, Ill.

Capstan car puller designed to handle from one to six 80-ton cars

NEWS of the FIELD

Construction of Hardy Dam Progresses; 45,000-Hp. Plant to Be Ready in Spring

Power house at Hardy Dam under construction

THE NEW HARDY DAM hydro-electric project on the Muskegon River, fifteen miles northeast of Newaygo, Mich., is rapidly taking shape. The work on this 100-ft. high dam and 45,000-hp. hydro-electric plant of the Consumers Power Company is up to estimated schedule and all indications point to the completion of the project early next spring.

The dam proper is an earth embankment placed across the valley, 3,000 ft. long, 100 ft. high, and about 700 ft. wide at the base. Approximately in the center of this embankment is a row of heavy steel piling driven deep into the ground and capped by a concrete corewall which extends up through the center for the full height of the dam. Three large concrete, steel-lined conduit tubes under the dam carry all of the water into the power house which is located at the downstream toe of the dam, 22.5 ft. below the river surface. A short distance upstream from the corewall is a large concrete intake tower that will project upward through the water surface of the reservoir, and in this tower are three giant steel gates which will control the inflowing water. Each of the three conduit tubes divides into two branches as it enters the power house, one branch carrying water to the turbines and the other branch being used in times of heavy river flow to discharge excess water through the dam. The power house will contain three generating units capable of a combined output of 45,000 horsepower.

In constructing the earth-fill embankment, almost a million and a half cubic yards of earth were required.

Plan New Gas Line for Southern California

CONSTRUCTION of a 26-in. gas line from Kettleman Hills to Los Angeles and Long Beach, Calif., is planned by the Southern Fuel Company, newly formed organization controlled by the Southern California Gas Company and Southern California Edison Company, Ltd. The line will have a capacity of 130,000,000 cu.ft. per day and will be built at a cost of approximately $7,000,000. Construction will begin about Apr. 1 of this year. The Kettleman Hills oil and gas field is in northwestern part of Kern county, Calif. Length of the line will be approximately 225 miles.

Management of the Southern Fuel Company will be under the direction of Alexander B. MacBeth, president of Southern California Gas Company, and other executives of that company and the Southern California Edison Company.

It was announced that the new gas supply will be needed to meet the demands of the domestic and industrial consumers of gas in Southern California and the fuel requirements of the Long Beach steam generating station of Southern California Edison Company. The capacity of the proposed line will equal about one-third of the total amount of gas handled in this area at present.

Utilities Usurp Rule of People, Pinchot Declares

"TWO FORCES are struggling for control of the governments of Pennsylvania and of the United States," Governor Gifford Pinchot declared in his inaugural address Jan. 20, and the continuance of government by the people is at stake, he asserted.

"Here in Pennsylvania a carefully planned, elaborately financed and powerfully directed attack upon the rule of the people under the law has made substantial progress," he said. "It aims to substitute government by the public utilities for government by the people. It is not confined to Pennsylvania. Not a single state in the Union is free from a similar attempt. . .

"Back of the public utilities in their attack on our American form of government is the whole fabric of political corruption; the underworld, the protected racketeer and criminals of high and low degree. . .

"The task today is to defeat the attack of the public utilities Government by utility magnates must not be substituted for government by the people. We have no more compelling duty than to destroy the corruption upon which the power of the utilities depends."

Governor Pinchot advocated the abolition of the present Public Service Commission of Pennsylvania, which he characterized as a "catspaw" of the utility corporations, and the establishment of a "Fair Rate Board," to which all citizens of the state could apply for the adjustment of unfair rates charged by the utilities.

NEAR THE BIRTHPLACE OF CHRIST

Wide World

The Rutenberg development in Palestine is rapidly nearing completion. Harnessing the waters of the Yarmuk and Jordan Rivers, of Biblical fame, this development consists of a 24,000-hp. hydro-electric project and an elaborate system of storage reservoirs and irrigation works. Three 8,000-hp. Francis inward-flow turbines are being installed in the power house. An idea of the desolate character of the country can be gleaned from this general view of the project

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Roosevelt Accepts Report Of St. Lawrence Commission

IN A SPECIAL MESSAGE to the New York State Legislature Jan. 19, Governor Roosevelt accepted the principal recommendations of both the majority and minority of the St. Lawrence Power Development Commission, as reported last week in *Power*, and requested creation by the legislature of a power authority to carry forward plans for the public development of hydro-electric resources of the International Rapids section of the St. Lawrence River.

He stated that both reports entirely vindicate the claims and recommendations made by him in his 1929 message, and pointed out that the only divergence between the majority and minority opinions is over the question of power disposition by the power authority if it is unable to negotiate a satisfactory contract with existing utilities. The majority report states merely that some other disposition of power should be made; the minority report is more explicit in that it states definitely that if such a contract is unobtainable, then (a) a contract with another private company, existing or to be organized, should be negotiated, or (b) the power authority itself should construct the transmission and distribution system.

Hailing the commission's reports, as a great step forward in the ultimate attainment of his program of cheaper electricity for the homes and small consumers of the state, Governor Roosevelt concludes his message with:

"I desire to repeat, however, that both reports should be a source of gratification to those of us who have been interested in cheaper electricity in the homes. They show—first, that the power can be developed cheaply; second, that the rates at which it should be sold to the ultimate consumers should be fixed by contract in the interest of the consumer; third, that if the contract is impossible to obtain, alternative methods should be pursued which would ultimately place this power in the homes of our citizens at low rates; fourth, that the authorities of the United States and Canada have so far evidenced an attitude of friendly co-operation; fifth, that the time is ripe for the creation by the legislature of a power authority with legislative sanction to proceed to carry to completion its negotiations as well as such further necessary studies as need be made of the building of transmission lines by the state, or the possibility of the creation of a new corporation to undertake to contract with the state for the transmission of this cheap electricity."

V.D.I. to Celebrate 75th Anniversary in June

GERMANY'S GREATEST ENGINEERING SOCIETY, the Verein Deutscher Ingenieure, will celebrate the 75th anniversary of its founding at its 70th annual meeting to be held at Cologne June 26 to 29. Appropriate ceremonies, historical papers, interesting technical sessions and inspection trips are planned, according to an announcement of the tentative program.

The celebration will open with an exposition on the history of the V.D.I., followed by an unveiling of a memorial to Langen and Otto, the inventors of the gas engine. During the four-day meeting many interesting papers will be presented on the history of engineering and invention.

At the technical sessions papers will be given on the welding of boilers and pipe lines, education and training of engineers, flow research, steam and hydraulic turbines, mining machinery and aluminum alloys.

Hudson County Adopts New Smoke Ordinance

THE HUDSON COUNTY BOARD of Health and Vital Statistics on Jan. 21 adopted a smoke ordinance, prohibiting the making of dense smoke within the limits of Hudson County, N. J., and establishing a Department of Smoke Regulation. This ordinance is based on the standard smoke ordinance of the United States Bureau of Mines, which was compiled by Dr. O. P. Hood, chief engineer of the bureau and an authority on smoke abatement. It was drawn up under the direction of Col. Elliott H. Whitlock, professor of mechanical engineering in charge of smoke abatement research at Stevens Institute of Technology, and William G. Christy, recently appointed smoke abatement engineer of Hudson County, with the assistance of H. K. Kugel, acting smoke commissioner of Cleveland.

Dense smoke is defined in the ordinance as being equivalent to No. 3, or greater on the Ringelmann chart, or as being so thick at the point of emission that it cannot be seen through. The ordinance prohibits the production or emission of dense smoke, fly-ash or fumes from any smoke stack or open fire, except that from a locomotive or steamboat for a period or periods aggregating two minutes in any period of fifteen minutes. It also prohibits smoke equivalent to No. 2 of the Ringelmann chart from any stationary plant or open fire for a period or periods aggregating twelve minutes in any period of one hour. No. 2 smoke is defined as being so dense that it can be dimly seen through.

From a locomotive or steamboat, dense smoke is prohibited for a period or periods aggregating thirty seconds in any period of three minutes. No. 2 smoke from a locomotive or steamboat is prohibited for a period or periods aggregating four minutes in any period of fifteen minutes.

The ordinance also requires that any person or corporation constructing or reconstructing, altering or repairing any furnace, boiler, furnace stack or apparatus connected with a stack, shall secure a permit for such work from the smoke department. An advisory board of three engineers is created by the ordinance. This board acts as a court

of appeals and anyone applying for a permit may appeal from the decision of the smoke abatement engineer to the advisory board.

Dr. Harvey N. Davis, president of Stevens Institute of Technology, was appointed chairman of the advisory board, with Roy V. Wright, president of the American Society of Mechanical Engineers, and Col. Elliott H. Whitlock as members.

Any person or corporation violating any prohibition or requirement of the new Smoke Ordinance is subject to a fine not exceeding $50 or imprisonment in the county jail or workhouse for not more than 30 days, or both. Each day's violation constitutes a separate offense.

A.S.M.E. Member Asks for Data on Distribution Costs

IN A LETTER, published in the Jan. 22 issue of the *A.S.M.E. News*, Morris L. Cooke, a member of the society, makes an urgent plea for the presentation of more data on electric distribution costs. Asserting that there are no commonly accepted standards of distribution, he recommends that engineering societies should foster the exchange of ideas on the subject with the idea of establishing some known basis for calculating the cost of electric distribution. In part his letter reads:

"Engineering literature teems with discussions bearing on the generation and transmission phases of electric service. Our own publications have included these subjects as within the area of our concern. But as to the third grand division of electrical activity, that is in the field of distribution, wherein engineering expenditures totaling at least several hundred million dollars are made annually, we have nothing to say.

"In an article recently appearing in the *National Municipal Review* there occurred this footnote:

"'As to distribution costs one must rely largely upon individual opinion. Curiously enough there are no commonly accepted standards as to distribution costs as there are for generation, transmission and other features of electric service. Distribution expense is an item peculiar to domestic service. It has never been discussed before any engineering or other technical gathering. This all-important technical detail is held to lie outside the field of engineering. Its discussion is virtually prohibited.'

"By research and discussion—much of the latter in open meeting—engineers have whittled the cost of generating electric current from coal until steam stations can compete with all but the very best water powers. In 1929 they were getting '97 per cent more energy from 30 per cent more fuel since 1921.' Why should not the same technique be applied to the engineering of distribution? Why should we permit any more mystery about distribution costs than there is about generation and transmission costs?

"Largely because our engineering societies have had 'thumbs down' on any discussion of electric distribution costs, American householders and storekeepers — groups all but defenseless under our system of regulation—are turning in increasing numbers to non-engineering and non-technical agencies for light and counsel. Can we rightfully longer ignore this situation?"

Lehigh U. Announces Research Fellowships

UNTIL APR. 1 applications will be received for appointment to various research fellowships in the Institute of Research of Lehigh University, according to an announcement of C. R. Richards, president of the university. The fellowships are as follows: Henry Marison Byllesby Research Fellowship in any branch of science or technology dealing with technical problems of interest to the public utilities; James Ward Packard Research Fellowship in electrical or mechanical engineering; C. Kemble Baldwin Research Fellowship in any branch of science having a direct bearing on aeronautical engineering, and two or more Institute of Research Fellowships.

Candidates for these fellowships must be graduates of institutions whose requirements are the equivalent of those of Lehigh University. Preference will be given to those who, following graduation, have had a year or more of practical experience. Appointments will be made for a period of two years of ten months each, during which the fellow will devote half of his time to research work under the direction of the department to which he is assigned and the other half to graduate study leading to the degree of Master of Science. The stipend for the Byllesby, Packard and Baldwin Fellowships will be $750.00 and for the Institute of Research Fellows, $600.00, for each ten-month period with freedom from tuition fees.

Public Works Committee Formed to Aid Employment

AS AN OUTGROWTH of a conference called by Col. Arthur Woods, chairman of the President's Emergency Committee for Employment, of representatives of architects, contractors, engineers, labor, and the steel, cement and lumber industries, there has been formed a Public and Semi-Public Works Section of the President's committee.

The purpose of this section is to endeavor to ascertain why public or semi-public works projects authorized and for which appropriations have been made, are not going forward, and knowing these causes to give consideration to ways and means for removing them so that the work may be undertaken promptly.

Iowa Governor Asks for Regulation of Utilities

STATE REGULATION of public utilities in Iowa, which is one of the few states not exercising such control at present, and encouragement of municipal ownership of utilities by enabling cities and towns to purchase power plant equipment on the instalment plan was asked by Governor Dan W. Turner in his inaugural message to the Legislature, Jan. 15.

"This question," he said, "ought to be given serious consideration at this session and a law enacted which shall provide for state regulation of all public utility companies so that the public shall be guaranteed just rates measured by cost of production. An adequate method should be provided for arriving at and determining the value of the properties of public utilities located within the state. This will assist in the matter of rate-making and will be of benefit in connection with the taxation of these companies.

"Municipal ownership of utilities should not be discouraged. Improved machinery for generating electric current on either a large or small scale, and at a low cost, makes it practicable in some instances to erect municipal plants, to be paid for out of the earnings thereof. However, this cannot now be done because there is no statutory provision therefor.

"A statute should be enacted in this session granting authority to cities and towns to contract for municipal utility plants to be paid for from earnings of said plants."

Plans Announced for Hyder, Alaska, Project

MORE COMPLETE DETAILS of the plans of the Portland Canal Power Company to develop a project on the Davis River in Alaska to furnish power to the towns of Hyder, Alaska, Stewart, B. C., and sawmills and mines in the vicinity have been given out by Willis T. Bacheller of that company. The dam site, approximately 2,100 ft. back in the Davis River canyon from the power house site, is in a granite gorge 20 ft. wide at the bottom and 100 ft. wide at the top. Plans for the first part of the development contemplate the erection of a 350-ft. dam and installation of two 7,500-hp. reaction turbines. Eventually the dam will be raised to a height of 600 ft., according to the plans, and two more units will be installed, giving the plant an ultimate capacity of 50,000 hp. The present reaction turbines are designed to operate at 350-ft. and 600-ft. heads with approximately the same efficiency.

The power house will be built at sea level. Water from the reservoir will be conveyed through a 16-ft. concrete-lined tunnel for 1,600 ft., and through a steel penstock for 500 ft. additional, there branching into two 6-ft. intakes.

P. G. & E. to Spend $35,000,000 in 1931

A 1931 CONSTRUCTION BUDGET of $35,000,000 has been adopted by the Pacific Gas & Electric Company and associated companies of California. Of this $28,000,000 will be expended for electric power development and $7,000,000 for the extension of gas facilities. During 1930 the company spent $40,000,000 for new plant and equipment.

Among the important items on the 1931 budget are the completion of the initial installation of the 228,000-hp. hydro-electric development on the Mokelumne River; the completion of reconstruction at Station "A", the company's principal steam plant in San Francisco whose capacity is being raised from 85,000 to more than 300,000 hp., and the erection of a new 50,000-kw. steam plant at Herndon on the San Joaquin Light & Power Corporation's system.

In addition, important extensions to the company's natural gas system are contemplated this year. Plans are afoot for a second pipe line into San Francisco from Milpitas, where it will tap the Kettleman Hills-Bay line. The cost of constructing this new line is estimated at $2,000,000.

1930 Stoker Sales 21% Under 1929

TOTAL SALES of mechanical stokers during the year 1930 amounted to 1,179 stokers of 365,664 hp., according to reports received by the United States Bureau of Census from the eleven leading manufacturers of this type of equipment. Compared with a total of 1,716 stokers of 599,585 hp. for 1929, sales last year showed a decrease of approximately 21 per cent.

December sales of mechanical stokers totaled 53 stokers of 11,726 hp., as compared with 71 of 21,103 hp. in November, and 79 of 44,976 hp. in December, 1929.

Of the total number sold during 1930, 590 stokers of 282,752 hp. were installed under water-tube boilers, and 589 of 82,912 hp. were installed under fire-tube boilers.

Four Large Japanese Power Companies Merge

A PROJECT to establish a common steam-electric generating company has been decided upon by representatives of the four big power companies in the western district of Japan, the Nippon Electric Power Company, the Daido Electric, the Ujigawa Electric, and the Kyoto Electric Light Company, according to *Denkinotomo*, a Japanese publication. The item continues: "The company will have an authorized capital stock of 20 million yen and will develop 100,000 kw. for the first period by installing three generators of 35,000-kw. capacity each. The output will be sold to the four companies and in case the dividend surpasses 8 per cent per annum, the surplus will be refunded to the four companies according to the amount of power purchased by each."

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 15-18. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting in Pittsburgh, Pa., March 9-13. District meeting in Rochester, N. Y., May 6-10. Annual summer convention in Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Stevens Hotel, Chicago, Ill., Aug. 4-8. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

Personals

WILLIAM V. KING, former chief accountant of the Federal Power Commission, was recently reappointed to his old post by the newly reorganized commission. CHARLES A. RUSSELL, former solicitor of the commission, was denied reappointment by the new body.

R. R. WASON has been elected president of Manning, Maxwell & Moore, Inc., to succeed C. A. Moore, who had been president of the company since April, 1927. Mr. Moore has been made chairman of the board of directors. Mr. Wason was also elected president of the Consolidated Ashcroft Hancock Company, one of the large subsidiaries of Manning, Maxwell & Moore.

FREDERICK W. MIERKE, for the past two years turbine engineer with the General Electric Company at Schenectady, N. Y., has recently joined the engineering department of the Beloit Iron Works, Beloit, Wis.

WILLIAM L. BATT, president of S K F Industries, Inc., has been appointed a director of the recently created Research Foundation at Purdue University.

MALCOLM CARRINGTON, formerly director of finished stocks of the Westinghouse Electric & Manufacturing Company, has been made assistant to the vice-president of the company. Other recent changes in the Westinghouse personnel include the appointment of HERBERT A. MAY as assistant to the president, the appointment of A. S. DUNCAN as manager of shipping stocks and the assignment of H. C. MCELHONE to duties in connection with analytical reviews of office operation and order procedure.

CLYDE L. SEAVEY has been re-elected president of the California Railroad Commission for 1931. Appointed originally by former Governor Stephens in January, 1923, Mr. Seavey served as president of the Commission during 1923, 1924 and 1930.

S. FARQUHARSON, formerly designing engineer with the Alcoa Power Company of Arvida, Quebec, has organized the consulting firm of S. Farquharson & Associates, with offices in Montreal.

W. A. THORPE has been appointed assistant to the manager of the federal and marine department of the General Electric Company. Other recent changes in the company's personnel include the election of T. K. QUINN and C. E. WILSON as vice-presidents, the election of H. H. Barnes, Jr., as a commercial vice-president, the election of J. L. BUCHANAN as president of the General Electric Supply Corporation and the retirement of Vice-President C. E. PATTERSON and C. C. CHESNEY, one of two vice-presidents in charge of manufacturing.

Business Notes

INDUSTRIAL BROWNHOIST CORPORATION, Cleveland, Ohio, announces that its directors have decided to consolidate the Cleveland and Bay City manufacturing operations of the corporation in one plant at Bay City, Mich., as promptly as conditions make it possible. The general offices of the corporation, including the administrative, financial, sales, purchasing, accounting and part of the engineering departments, will be retained at Cleveland, according to the announcement. It is estimated that from six to eight months will be required for the gradual transfer of the manufacturing operations to Bay City before closing the Cleveland plant.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that orders received during the year 1930 amounted to $341,820,312, as compared with $445,802,519 for 1929, a decrease of 23 per cent. Orders for the final quarter of 1930 were $74,168,480, compared with $108,398,049 for the last quarter of 1929, a decrease of 32 per cent.

HIMELBLAU, AGAZIM & COMPANY, Chicago, Ill., announce the removal of their pipe-welding and fabricating shop to the Central Manufacturing District at 74th and Ashland Ave., Chicago, where larger facilities are available.

LINK-BELT LIMITED, Toronto, Montreal and Vancouver, Canada, announces the appointment of two new sales representatives in the prairie provinces. Manitoba Bridge & Iron Works Ltd. of Winnipeg will represent Link-Belt in Manitoba and Saskatchewan, and Riverside Iron Works Ltd. of Calgary will represent the company in southern Alberta.

How's Business?

THE ABILITY of business to hold the line is becoming impressive, and is far more significant than its failure to make any spectacular gains. This resistance to further retreat has been evident in practically every indicator since the middle of December — in steel, coal, electric power production; in merchandise carloadings; and particularly in building contracts. Commodity prices and stocks have likewise shown a persistently narrow range of fluctuation, and on the positive side, the bond market has made a fairly good recovery from its slump in the last quarter of 1930. Our index of general business activity has held above the Hindenburg line of 75% of normal for six weeks, with a slight upward drift. This week it still clings close to 80%.—*The Business Week*, Jan. 28.

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WITH THE SOCIETY SECTIONS

A.S.M.E., Anthracite-Lehigh Valley Section. Meeting in the ballroom of the Necho-Allen Hotel, Pottsville, Pa., Jan. 30. Subjects "Compressed Air," by M. C. Davison, Ingersoll-Rand Company; "Development of Cast-Alloy Steels and Irons, Their Use in the Mining Industry," by George Batty, Steel Casting Development Bureau.

A.S.M.E., Boston Section. Inspection trip to Edison Plant, followed by meeting at the Engineers Club, Feb. 18 at 7:30 p.m. Subject: "Central Heating in Boston," by D. S. Boyden and M. D. Engle, Edison Electric Illuminating Company of Boston.

A.S.M.E., Cleveland Section. Meeting in the Cleveland Engineering Society rooms on Feb. 2 at 8 p.m. Subject: "High Pressures and High Temperatures in Central Stations and Industrial Plants," by George A. Orrok, consulting engineer.

A.S.M.E., Kansas City Section. Meeting at Northeast Station of the Kansas City Power & Light Company late in January. Subjects: "Design of Power Plant Instruments and Valve Specialties," by representative of Manning, Maxwell & Moore Company; "Value of Instruments to Steam-Power Plants," by Raymond Winters, Kansas City Power & Light Company.

A.S.M.E., Metropolitan Section. Meeting at Fraternity Clubs Building on Feb. 6. Subject: "The Scope of Management in Our Future Business Development," by J. P. Jordan, Stevenson, Harrison & Jordan.

A.S.M.E., Ontario Section. Meeting at the University of Toronto on Jan. 30 at 8 p.m. Subject: "Modern Steam Power Plants," by Prof. A. G. Christie, Johns Hopkins University.

A.S.M.E., Syracuse Section. Meeting on the roof garden of the Hotel Onondaga, Feb. 2 at 8 p.m. Subject: "Loeffler Boilers," by A. J. Herschmann, American representative of Loeffler Company.

A.S.M.E., West Virginia Section. Meeting at the Ruffner Hotel on Jan. 30 at 6:30 p.m. Subject: "Trenton Falls Hydro-Electric Development," by George A. Orrok, consulting engineer.

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Trade Catalogs

METERS—A new edition of "Registers of Revenue," a 16-page illustrated bulletin describing watthour and demand meters, has just been issued by the Westinghouse Electric & Manufacturing Company, Newark, N. J. This publication, designated as Circular 1753-B, includes for the first time a detailed description of the new "Ob" detachable watthour meter.

BOILERS—Design information and dimensioned drawings descriptive of the Wright boiler are included in a new booklet, No. 10, of Paul Wright & Company, Birmingham, Ala. The booklet is profusely illustrated with pictures of actual installations and contains much valuable data on this patented boiler.

ELECTRICAL EQUIPMENT—The Square D Company, Detroit, Mich., has recently issued two new bulletins. One describes the company's convertible safety panel, and the other, written by its director of engineering, J. G. Jackson, deals with heating in switches and panelboards.

DIESEL ENGINE—Circular No. 24, recently issued by the Hill Diesel Engine Company, Lansing, Mich., describes and illustrates a recent addition to the company's line of small Diesel engines, the "Little Aristocrat," a four-cylinder engine developing 30 to 40 hp. at 1,500 to 2,000 r.p.m. This engine is adapted to small electric generating plants and for marine work.

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Fuel Prices

FUEL OIL

New York—Jan. 22, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—Jan. 14, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.339 per bbl., or 42 gal.; 26@28 deg., $1.46 per bbl.; 28@30 deg., $1.589 per bbl.; 30@32 deg., $1.689 per bbl.; 32@36 deg., gas oil, 3.901c. per gal.; 38@40 deg., distillate, 4.526c. per gal.

Pittsburgh—Jan. 14, f.o.b. local refinery, 34@36 deg., fuel oil, 3.5c.@ 3.75c. per gal.; 36@40 deg., 3.37½c.@ 3.75c.

Philadelphia—Jan. 20, No. 4, light, $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy (Bunker C) $1.10.

Cincinnati—Jan. 20, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Jan. 16, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 60c. per bbl.; 22@26 deg., 67.5c. per bbl.; 26@30 deg., 80c. per bbl.; 30@32 deg., 95c. per bbl.; 32@36 deg., gas oil, 2.25c. per gal.

Boston—Jan. 19, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@ 32 deg., 4.8c. per gal.

Dallas—Jan. 17, f.o.b. local refinery, 24@26 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.90 @$2.25
Pool 10, h. gr. low-vol.	New York...	1.75 @ 1.85
Pool 11, low-vol.....	New York...	1.60 @ 1.75
Smokeless, mine-run..	Chicago.....	1.75 @ 2.25
Smokeless, slack.....	Chicago.....	.75 @ 1.35
Harlan, Ky., slack....	Chicago.....	.50 @ .90
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.35 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.50 @ 1.85
Standard Ill., mine-run	St. Louis....	1.25 @ 1.60
W. Ky., mine-run	Louisville....	1.00 @ 1.35
W. Ky., slack.....	Louisville ...	.30 @ .60
Pittsburgh, mine-run.	Pittsburgh...	1.35 @ 1.45
Smokeless, mine-run..	Cincinnati...	1.75 @ 2.25
Smokeless, slack.....	Cincinnati...	.75 @ 1.35
Kanawha, mine-run..	Cincinnati...	1.10 @ 1.35
Kanawha, nut-slack.	Cincinnati...	.55 @ .85

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York...	$3.50
Barley.....	New York...	1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Long Beach — Southern California Edison Co., 306 West 3rd St., is having plans prepared for the construction of a 135,000 hp. additional unit to steam plant here. Estimated cost $7,500,000. Stone & Webster Engineering Co., c/o H. F. Hendrickson, Mgr., 510 Laughlin Bldg., Los Angeles, are engineers.

Calif., San Francisco—San Francisco Shriners, Islam Temple, plans the construction of a shrine temple. Estimated cost $2,000,000. Architect not selected.

Conn., Middletown—State of Connecticut, Lone Lane Farm, C. Penniman, is having plans prepared for the construction of a group of school buildings including boiler house and service units, etc. Estimated cost $300,000. Towner & Sellew Associates, 329 Main St., are architects.

Idaho, Idaho Falls—City has made application to Federal Power Commission for permit to construct a 19,000 hp. hydro-electric plant on the Snake River. Estimated cost $2,000,000. C. R. Black, is city engineer.

Ill., Champaign — University of Illinois, awarded contract for the construction of an ice skating rink at 5th and Armory Sts. to Trimmer-Nydele Co., 111 West Washington St., Chicago. Estimated cost $200,000. Refrigeration contract not yet let.

Ill., Chicago — Motorists Association of Illinois, 3254 South Michigan Ave., awarded contract for the construction of a 10 and 19 story club and hotel building at Michigan Ave. and 24th St. to Paschen Bros., 33 North La Salle St. Estimated cost $1,600,000.

La., New Orleans—Sewerage & Water Board, G. G. Earl, Gen. Supt., awarded contract for extension to drainage pumping station 7 at Florida Ave. and Orleans St. Cont. 118-D, to Gervais F. Favrot, Baltimore Bldg. $110,703.

Mass., Boston — Dept. of Public Works, is having preliminary sketches made for the construction of an office building at Summer St. Ext. or Nashua St. Estimated cost $1,000,000. Adden, Parker, Clinch & Crimp, 177 State St., are architects.

Mass., Wellesley—Town awarded contract for addition to pumping station on Worcester St. to Hill & Delaney, 108 Massachusetts Ave., Boston. Estimated cost $40,000.

Mass., Worcester—Worcester County Commission, E. W. Glidden, Court House, is having plans prepared for the construction of a sanitorium including hospital, nurses' home, service building, 80x85 ft. power house, etc., at Huntington Farm. Estimated cost $450,000. Frost, Chamberlain & Edwards, 390 Main St., are architects.

Mo., Clarkton—City awarded contract for pump house to N. E. Douglas, pump to Stewart Machinery Co., Buder Bldg., St. Louis. Estimated total cost $20,000.

Mo., St. Louis—U. S. Engineer, 428 Custom House, awarded contract one 800 kw. turbo generator set, one reduction gear and steam turbine 100 kw. turbo generator set complete, reduction gear and steam turbine, 1,000 hp. d.c. motor, and switchboard and control equipment for Dredge Fort Chartrees to Elliott & Co., Railway Exchange Bldg. Total cost $61,778.

N. J., Atlantic City—Schultze & Weaver, 18 East 48th St., New York, N. Y., Archts., are receiving bids for a 24 story hotel including steam heating and ventilation systems, boilers, elevators, etc., at Park Ave. and Boardwalk here for Marlborough-Blenheim Hotel, Atlantic City. Estimated cost $1,000,000.

N. J., Hillsdale—Dept. of Institutions and Agencies, State Office Bldg., Trenton, is having plans prepared for the construction of a 3 story medical building including steam heating and ventilation systems, boilers, etc., here. Estimated cost $1,500,000. Guilbert & Betelle, 20 Branford Pl., Newark, are architects. C. N. Leatham, Jr., Div. of Archt. and Const., State Office Bldg., Trenton, is associate architect.

N. J., Jersey City—Springarn Realty Co., J. Springarn, Pres., 590 Summit Ave., will receive bids about Mar. 1 for the construction of a 9 story office and stores building including steam heating and ventilation systems, boilers, elevators, etc., at Newark and Oakland Aves. Estimated cost $750,000. W. Neumann, 26 Journal Sq., is architect and engineer.

N. J., Newark—St. Barnabas Hospital, J. G. Martin, Supt., 685 High St., postponed construction of 5 story hospital, nurses home and power house. $1,500,000. J. H. and W. C. Ely, 605 Broad St., Archts. Indefinite when project will mature.

N. J., Perth Amboy—Bd. of Commissioners, City Hall, plans addition to electric light plant. Estimated cost $40,000. Engineer not selected.

N. J., Perth Amboy—Norkin Co., Owner, c/o Warner Bros., Pictures Inc., 321 44th St., New York, Lessee, will soon award contract for the construction of a theatre and stores building, including steam heating and ventilation systems, boilers, etc., at Smith and Maple Sts. Estimated cost $1,000,000. John Eherson, 370 Lexington Ave., New York, is architect. Riederman & Severend, 370 Lexington Ave., New York, are engineers.

N. Y., Central Islip—Dept. of Mental Hygiene, State Capitol, Albany, will receive bids until Feb. 25 (extended date) for alterations to present dining room, kitchen building, service connections and power house equipment at Central Islip State Hospital here.

O., Cleveland—Juvenile Courts Building Commission, F. J. Husak, Clk., Court House, plans the construction of a group of buildings for detention home including steam heating, ventilation and refrigeration systems, elevators, etc., at East 22nd St. and Central Ave. Estimated cost $1,650,000. F. W. Bail, Hanna Bldg., is architect.

O., Cleveland—Syndicate c/o J. A. Tuck, 1887 East 93rd St., Archt., is having preliminary plans prepared for the construction of a 16 story hotel at University Circle. Estimated cost $2,000,000.

O., Dayton—Mutual Home Building & Loan Association, Mutual Home Bldg., awarded concrete, cement, brick and carpentry contract for bank and office building to A. W. Kimmel, Inc., 480 Hoffman Ave. Estimated cost $1,000,000.

Okla., Ryan—City is having preliminary plans prepared for the construction of a municipal ice plant. Estimated cost $17,000. W. M. Crowe is engineer.

Pa., Safe Harbor—Safe Harbor Water Power Corp., awarded contract for four generators to General Electric Co., River Rd., Schenectady, N. Y., and two generators to Westinghouse Electric Mfg. Co., 150 Broadway, New York, N. Y., in connection with proposed $30,000,000 hydro-electric development on the Susquehanna River.

Tex., Beaumont—City c/o P. Millard, mgr., plans to erect and equip two new pumping plants and remodel old plant. Estimated cost $120,000. R. C. Black is city engineer.

Tex., Eagle Pass—Central Power & Light Co., Frost Bldg., San Antonio, is having plans prepared for the construction of a hydro-electric plant 10,000 hp. capacity on irrigation canal adjacent to Rio Grande River near here. Plans include two or three generating units. Estimated cost $1,400,00. Private plans.

Tex., El Paso—El Paso Electric Co., plans extensions and improvements to electric light and power plant including large dynamo unit, and other new equipment and machinery. Estimated cost $150,000. Private plans.

Tex., San Antonio — San Antonio Public Service Co., 201 North St. Marys St., plans to expend $500,000 during 1931 for changes in sub-station equipment to include considerable new power equipment, some enlargements of sub-stations and replacement of other equipment.

Tex., Waco—U. S. Veterans Bureau, Arlington Bldg., Washington, D. C., will receive bids until Feb. 21 for a group of buildings, including boiler plant, refrigeration and ice making plant at U. S. Veterans Hospital here.

Tex., Yoakum—City, c/o E .S. Wimfrey, will receive bids until Feb. 6 for the construction of a complete waterworks system to include reservoir, pumping station, two deep well pumps, two booster pumps; also power and lighting system, including complete distribution system, power plant building, cooling tower, fuel oil tanks, power and auxiliary equipment, etc. Montgomery & Ward, Snider Bldg., Wichita Falls, are consulting engineers.

Utah, Mount Pleasant—City awarded contract for electrical equipment for proposed hydro-electric plant to General Electric Co., Salt Lake City. $11,620. Contract for power plant will be let about April 1.

Utah, Price—City received lowest bids for the construction of a Diesel engine plant from Fairbanks-Morse, Salt Lake City, $109,000 and steam plant from Hunt Mirk & Co., 141 Second St., San Francisco, Calif. $170,000. C. Nyman, Helper, is engineer.

N. B., Fredericton—Syndicate c/o I. B. McNair, Barrister, plans the construction of an artificial ice plant here. Estimated cost $50,000.

Ont., Niagara Falls — Water Commission, awarded contract for furnishing and installing switching equipment at pumping station to Canadian Westinghouse Co., Hamilton, $38,000, and ten filters to Roberts Filter Co., 11 King St. W., Toronto. $90,000.

Ont., Toronto—Maple Leaf Hockey Club, 13 King St. W., plans the construction of a hockey arena and show building including artificial ice plant, etc. at Yonge and Fleet Sts. or Yonge and Carlton Sts. Estimated cost $1,250,000. Architect not selected.

Equipment Wanted

Boilers, etc.—Cleveland, O.—Bd. of Education F. G. Hogen, Dir., will receive bids until Feb. 2 for steam heating boilers and settings and temperature regulator for James Ford Rhodes School. Estimated cost $95,000.

Engine, Governor, Alternator and Exciter—Opelousas, La.—City Council, will receive bids until Feb. 10, for furnishing and installing one 950 to 1,000 hp. vertical, multi-cylinder Diesel engine, either 2 or 4 stroke cycle, motor operated governor, alternator, 650 kw. and exciter, switchbord, etc.

Generator—Berea, O.—City, T. R. Barnum, plans to purchase a 1,000 kw. turbine generator.

Heating Plant Equipment—Terre Haute, Ind.—State Teachers College Board, H. C. Benbridge, Secy., will receive bids until Feb. 3 for equipment for heating plant at Indiana State Teachers College.

Pumping Unit, etc.—Tenaha, Tex.—City will soon receive bids for pumping unit, etc., in connection with proposed waterworks. Estimated cost $35,000.

Pump—Hammond, La.—City Council, will receive bids until Feb. 3 for installing a 1,000 dual drive fire pump, also making repairs to present pump for proposed waterworks improvements.

Pumps, etc.—New Lisbon, N. J.—Burlington County Freeholders, Mount Holly, will receive bids until Jan. 30 for artesian well, 16 in. diameter at County Building to include electrically operated vertical turbine pumps, etc.

Industrial Projects

Arizona — Hope Mining Co., Kingman, is having plans prepared for the construction of an 85 ton reduction mill, also electrification of underground workings.

Calif., San Jose—Liquid Sugar Corp., 637 Battery St., San Francisco, plans the construction of a 3 or 4 story refining and manufacturing plant here. Estimated cost $100,000. Private plans.

Conn., Bridgeport—Bridgeport Metal Goods Mfg. Co., awarded contract for the construction of a 2 story, 60x100 ft. addition to factory on Cherry St., to E. & F. Construction Co., 94 Wells St. Estimated cost $50,000.

Conn., Willimantic — Willimantic Silk Co., Inc., awarded contract for the construction of a 1 story, 53 x 222 ft. silk throwing mill to O. L. Willard, 70 Valley St. Estimated cost $52,000.

Ind., East Chicago—Inland Steel Co., is having plans prepared for the construction of a plate strip mill. Estimated cost $5,000,000. Private plans.

Minn., St. Paul — American Agricultural Chemical Co., 420 Lexington Ave., New York, plans the construction of a waterfront development and fertilizer manufacturing plant here. Estimated cost to exceed $150,000. Maturity indefinite.

O., East Liverpool — Peach Porcelain Co., manufacturers of porcelain specialties, plans to rebuild plant recently destroyed by fire. Estimated cost $75,000.

Pa., Oil City—National Transit Co., F. D. Williams, Pres., Seneca and Center Sts., plans the construction of a group of buildings including 160 x 285 ft. erecting and shipping building, 110 x 285 ft. finished pumps storage building, 86 x 190 ft. raw material warehouse, 65 x 84 ft. toolroom, tool making and jig storage building, 62 x 174 ft. casting, cleaning and welding building, 58 x 60 ft. production office and foundry extension, 32 x 182 ft. side floor for crane and remodeling light machine shop. Estimated total cost $300,000. Contracts let for machine shop and warehouse, also erecting and shipping building. Five, ten, twenty and twenty-five ton cranes will be required.

Pa., Pittsburgh—H. J. Lohrey Co., W. G. Lohrey, 2232 East St., (meat packers), are receiving bids for a 4 story, 50x50 ft. refrigeration plant. Private plans.

Tenn., Chattanooga—Davenport Hosiery Mills, 906 Georgia Ave., plans the construction of a hosiery mill, including dyeing plant, boiler house, etc. Estimated cost to exceed $100,000.

Wis., Menasha — Echl Stationers Corp., awarded contract for a 1 story, 75x160 ft. factory to New London Construction Co., New London.